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SAM COLLINS

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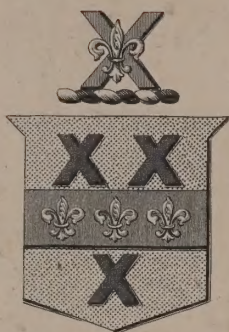




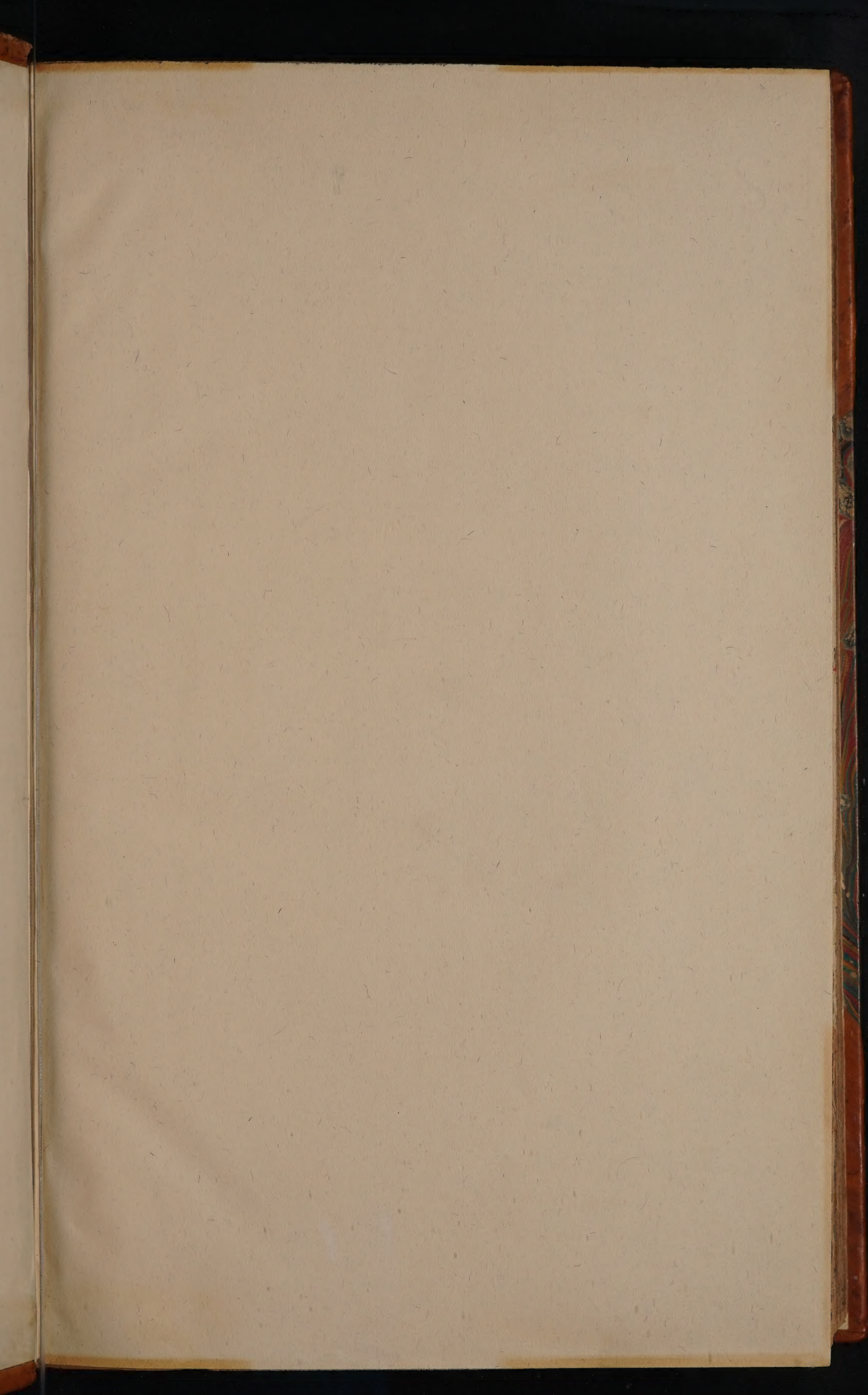


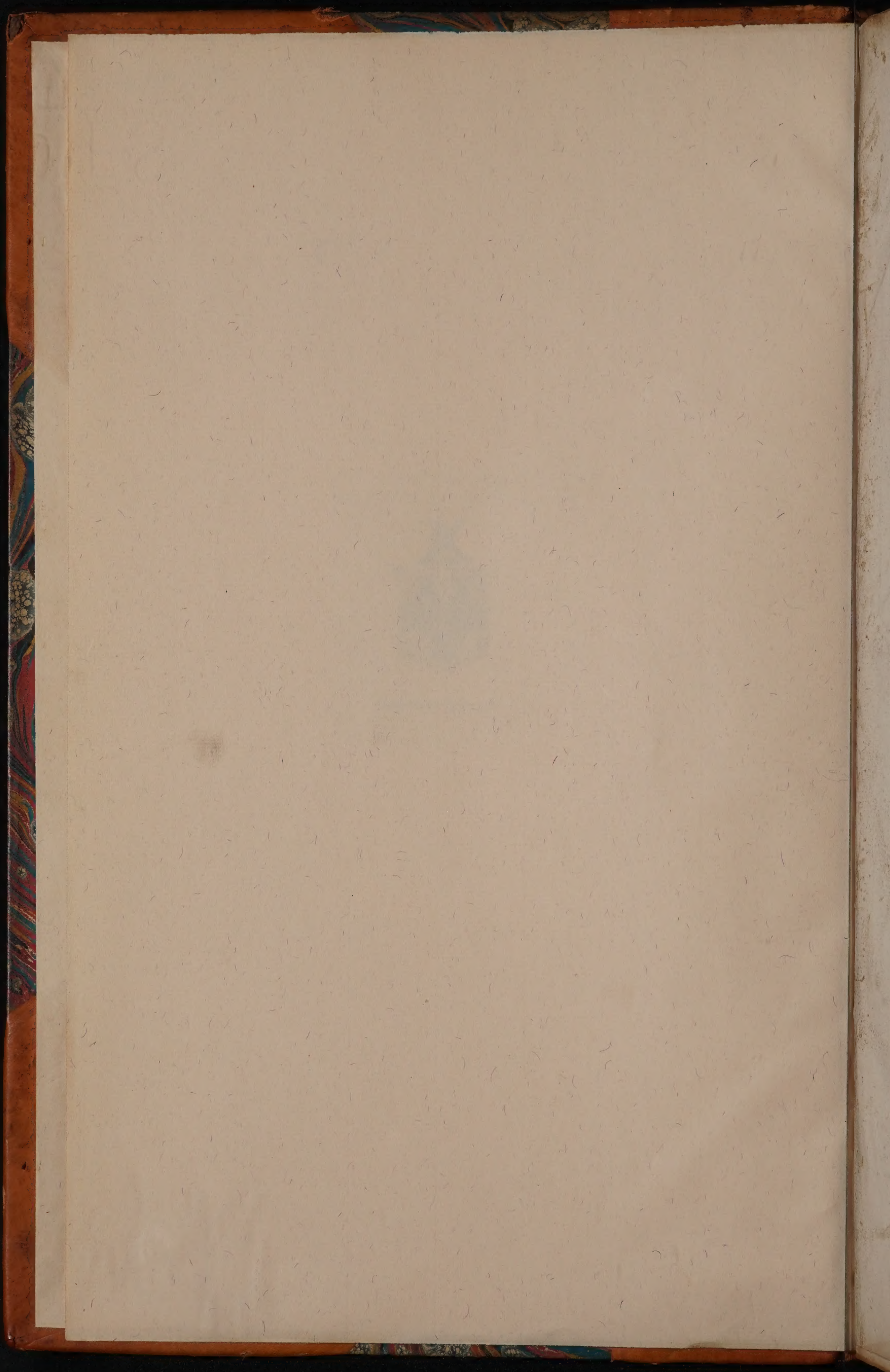
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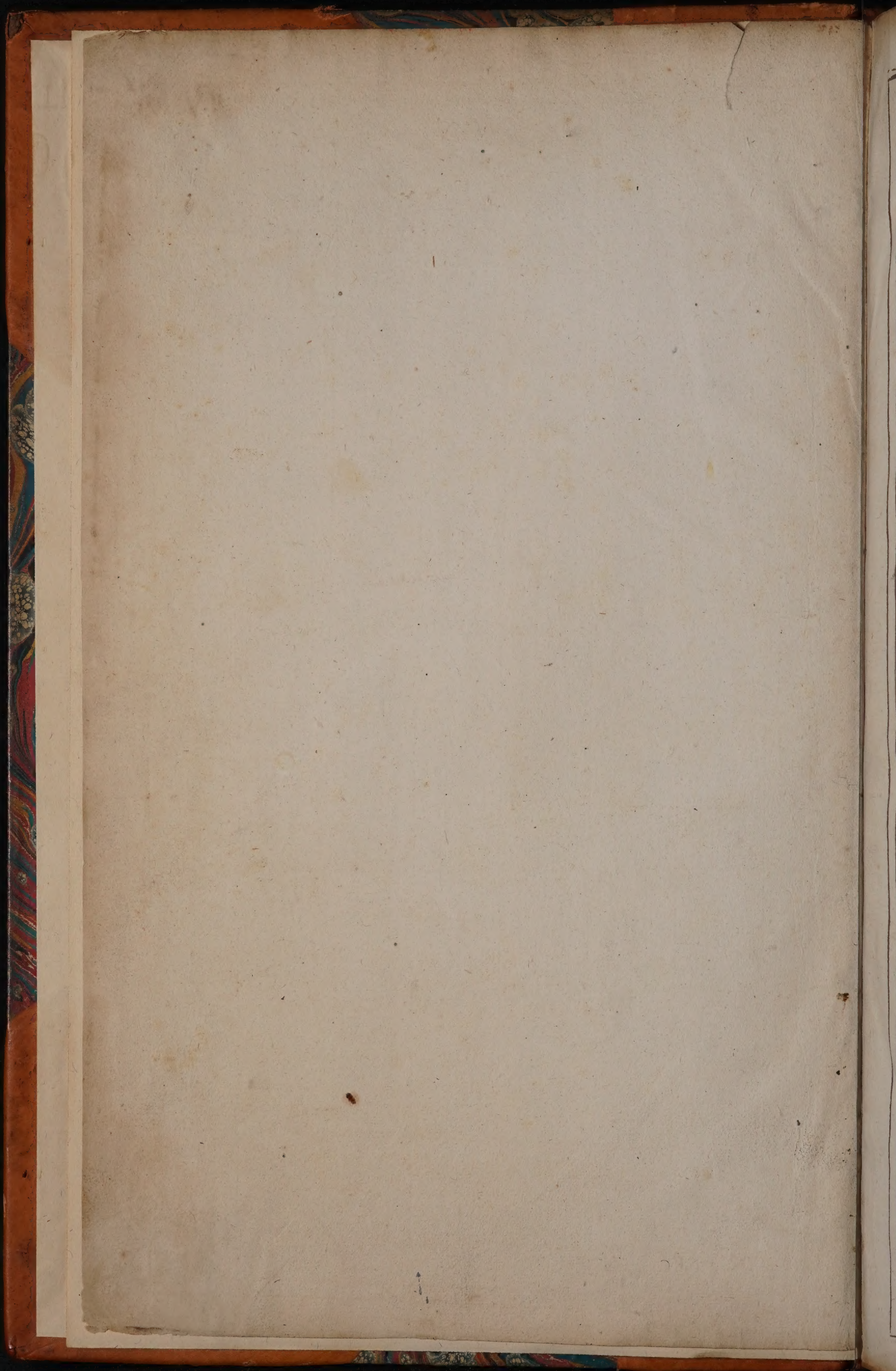


E. BARCLAY-SMITH, M.D.





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THE
SECOND VOLUME,
 CONTAINING
 The Parts of the Middle and Highest
 A PARTIMENT
 OF
MAN'S BODY
 (And other ANIMALS)

With its DISEASES, CASES, and CURES.

To which are added in the End Seventy three

S C H E M E S,

BEAUTIFIED

With many Elegant FIGURES, fully Explained by Letters
 and Notes, placed in Pages opposite to the TABLES, for the more ready
 Inspection and clear understanding of the Figures.

With a Large INDEX, Containing the most significant
 Words, and most Memorable Things of both Volumes.

By **SAMUEL COLLINS** Doctor in Physick.

Printed by THOMAS NEWCOMB, for the Author, MDCLXXXV.

THE
SECOND VOLUME
CONTAINING
The Parts of the Middle and Highest
APARTMENT
OF
MAN'S BODY

(And other ANIMALS)
With its Diseases, Cases, and Cures.

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SCHEMES

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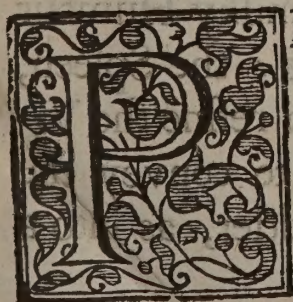
Printed by THOMAS NEWCOMB for the Author, MDCCLXXV.



TO THE
High Puissant, and most Noble Prince
H E N R Y
Duke of Norfolk,
Earl-Marshall of England,

Chief of the Noble Family of the *HOWARDS*, Earl of
Arundel, Surrey, Norfolk, and *Normich*, Baron *Mowbray*,
Howard, *Seagrave*, *Bruse* (of *Gower*) *Fitz-Alan*, *War-*
ren, *Clun*, *Oswaldestrey*, *Maltravers*, *Graystock*, *Verdon*,
Furnival, *Lovetot*, *Strange* (of *Blackmere*) and *Howard*
(of *Castle Rising*) Constable and Governor of his Ma-
jesties Royal Castle and Honor of *Windsor*, Lord War-
den of the Forest of *Windsor*, Lord Lieutenant of the
Counties of *Norfolk*, *Surrey*, and *Berks*, of the City
of *Normich* and County of the said City, and Knight
of the most Noble Order of the Garter, &c.

May it please your Grace,



Persons of great Honor, as highly Enobled
with a Liberal Education of Literature and
Vertue, do resemble the Heavenly Mind in
Humility and Goodness, and are Graciously
pleased to accept a small Present (offered
in great Devotion) which is humbly laid
at your Feet to give it your Patronage,

And

The E P I S T L E

And this untimely Birth wanting due Limbs and Lineaments, craveth the covert of your Graces Wing ; and it being attended with the ill circumstances of a mean Parent and its own Poverty, beggeth the favour of your Gracious reception, and the honor of your Pass to recommend it to the Charity of others.

Your Family is highly Renowned in Honor and Antiquity, as being descended from many Noble Progenitors, and is rendred numerous too, as being propagated into many Families of great Honor, Vertue, and Fortune, which make them very Valuable and Meritorious in the Eye of the World.

Your Goodly Personage is beautified with the fine Lineaments of a Graceful Visage, and Enobled with outward and inward Parts, disposed in elegant order : Your excellent frame of Body is adorned with a boun Mine, pleasant Language, and amicable Converse, highly endearing and commanding the hearts and hands of all that have the honor to be known to your Grace, whom I most humbly take the boldness to present with a fine Sight of the Parts of Man's Body (wherein you may see your own Stately Fabrick, clearly represented unto you as in a Glas) consisting of many outward Coverings enclosing each other as fine Walls guarding the more inward and Noble parts, supported by a fine Column of the Chine, composed of many joynts of the Vertebres of the Back, curiously carved into variety of Processes.

This elegant Pile of a Humane Body is made up of three Stories, the lowest is outwardly covered with the common Integuments and Muscles of the Belly, and more inwardly beautified with the fine Hangings of the Rim of the Belly and Caul, encircling the noble Furniture of the *Viscera*.

The Stomack is like a Retort, in which a milky Humour is extracted, and the Guts are its recipients ; the Spleen, Liver and Kidneys are so many Colatories to refine the Vital Liquor ; and the Ureters are Aquæducts to convey the strained watry parts of the Blood into the Bladder, as into a Cistern.

The middle Story of the Body is divided from the lowest by the interposition of the Midriff, as by a Floor, arched in its repose, and brought toward a Plane in motion ; this
Apartment

DEDICATORY.

Apartment is seel'd above by the *Clavicles*, and fortified before by the *Sternon*, as with a Breast-plate, and behind with the carved Spondyles of the Back, and on each side with many bony Arches of the Ribs, and more inwardly is adorned with the choice hangings of the *Pleura* and *Mediastine*, encircling the Heart, (as an Engine to move the Blood,) and the Lungs a Systeme of Pipes to fan and exalt the Blood by the elastick Particles of Air.

The third Apartment is embellish'd with a beautiful Frontispiece of the Face dress'd with variety of Colours, compos'd of many lights and shades, and of a fine symmetry of different parts, answering each other in due proportions. The Brain being the noble Householdstuff of this highest Story, is guarded with the Ivory Tables of the Skull, as with a Helmet, and clothed more inwardly with the coverings of the *Dura* and *Pia Meninx*, as with thin Vails: This delicate Compag of the Brain is made up of various Processes, beset with numerous streaks, which are so many Filaments entertaining the Animal Liquor and Spirits, the immediate Emissaries, the great Ministers of the Soul, by which it acts its more noble operations of Sense and Reason.

Thus I have shew'd You the pleasant prospect of the several Apartments, and their rich Furniture, relating to the magnificent Fabrick of Man, that your Grace may make a reflection upon your own Elegant Composition, and admire and adore the great Goodness, Wisdom and Power of the Omnipotent Architect, disposing all things to your own Person in due weight, number, and measure, and give this great heavenly Maker all Eucharist and Obedience by reason he hath imparted to you out of his infinite Mercy, such salutary methods of Vertue, express'd in Sobriety to preserve your excellent frame of Nature; So that your Grace hath served the ends of Nature and Creation, as you have demeaned your self in that *decorum*, which is most orderly in sensual Enjoyments proportionate to the Law of Nature, and perfective of a happy Life.

Your well compos'd and serene Temper is seated in a Haven of Ease and Repose, as secur'd against the Storms and Tempests of Passions, making your Grace capable to inspect the Secrets of Nature, and Mysteries of Religion, and contemplate the more Divine Attributes of the Eternal Being; and your regular Appetites hold conformity with
the

The EPISTLE, &c.

the more sober Dictates of Reason, as having inclinations to obey the Commands of the Understanding; whereby you become a Master of Prudence and Conduct, as being first a Governor of your Self, and so are rendred fit to Govern others, as being Constituted by His Sacred Majesty, a Great Minister of State in Civil and Military Affairs, wherein your Grace hath wisely deputed your Self with Justice and Equity to the Love and Admiration of others.

Your Amicable and generous Disposition, your great Courage and Gallantry of Mind, your profound Judgment and quick Apprehension, your life of Temperance, Charity, and Humility, have made you an Ornament of Mankind, and me perfectly your just Admirer and Votary, as all the Intellectual and Moral Perfections of your many Noble Ancestors are met in your Grace (as a Center of Vertue and Learning) to whom this Book is humbly Dedicated as an Oblation from

My LORD,

Your Graces most Obedient

and Obliged Servant

SAMUEL COLLINS.

BOOK II.

CHAP. I.

Of the common Receptacle and Chyliferous Thoracick Ducts.

IN the former Book I have endeavoured to entertain you with the pleasant sight of Utenfils relating to the lowest Apartment outwardly immured in its Exterior Region and Sides, with the four common Integuments and the Abdominal Muscles; and behind, with the *Musculi latissimi & longissimi dorsi, Sacrolumbares, quadrati & sacri*, and supported with Vertebres of the Loins as with a Column finely Carved with variety of Processes. And this lowest Story is more inwardly enclosed with the rim of the Belly and Caul, as curious Hangings (made up of many minute Filaments, rarely interwoven, and embroidered with variety of Vessels) encircling the *Pancreas*, Spleen, Liver, Kidneys, attended with the bladder of Gall and Urine, as Cisterns of bilious and serous Re-crements of the Blood.

I have also Treated of the various parts, manner and principles of Generation in Man and Woman (as well as in other Animals) espousing each other to impart a kind of Immortality to Humane Nature, and other Entities too, by innumerable repeated acts of Propagation.

And in order to preserve every particular Animal by a proper Nourishment, as well as the Species by Generation; I have given an account how Concoction is begun in some manner in the Mouth, by the Comminution of Aliment impregnated with Salival liquor (oufing out of the Excretory Ducts of the Glands belonging to the Pallat, Tongue, and adjacent parts) mixed with the Elastick particles of Air, opening the Compage of Meat afterward transmitted through the entry of the Gullet into the Kitchen of the Stomach, where the Concoction of the Aliment is farther Elaborated, as mixed with various Ferments of the mild parts of the Blood and Nervous Liquor (destilling out of the extremities of Arteries and Nerves) confederated in the glandulous Coat of the Stomach, and conveyed into its Cavity by secret Pores, whereby the body of the Aliment is opened, and a white Tincture extracted.

My design in this Book is to shew you the Noble Furniture of the middle Apartment of the Body, and its structure, actions, and uses; and in this Chapter, how the Milky humor is transmitted through the Guts and *Lactææ* of the Mesentry into the common receptacle; and afterward how it is conveyed through the Thoracick Ducts into the Subclavian Veins, Heart, and Lungs, wherein it is exalted by Local and Intestine motion, and then impelled with the Blood by the contraction of the Heart, and circular Fibres

of

of the Arterial Channels, into all the apartments of the Body in reference to Filtration in the Interstices of the Vessels and glandulous parts, belonging to the fine Contextures of the Membranes and *Viscera*, as so many strainers of Vital Liquor.

In order to its production, I intend now to discourse the Chyle as the *Materia substrata* of Blood, and of its motion through the Mesenterick and Thoracick Vessels into the Subclavian Veins, where the Chyle first espouseth the association of Blood.

Chyle is first
Extracted in
the Stomach,
and more re-
fined in the
Guts.

Chyle being a white Liquor somewhat resembling Barley Creme, is first extracted by Serous and Nervous Ferments out of Aliment concocted in the Stomach, and thence being transmitted into the Intestines, receiveth a farther Elaboration, appearing in its more white Colour and thinner consistence, by the Pancreatick and Bilious Liquors, and is afterward received into the Origins of the *Lactææ*, as much assisted by the Peristaltick motion of the Guts, and the Contraction of the Abdominal Muscles in Expiration.

The progress
of the Chyle
out of the
Guts through
the Mesente-
rick Glands,
wherein it is
Meliorated
and conveyed
to the com-
mon Recepta-
cle.
The seat of
the common
Receptacle.

The Chyle being carried by the first kind of Lactæal Vessels into the next Glands of the Mesentery, and in their substance is mixed with a choice Liquor, destilling out of the extremity of the Nerves, whereby it is improved, and then received into the Orifices of the second kind of *Lactææ*, and so transmitted into the common Cistern of Chyle and Lymphatick Liquor.

The Cavity of
the common
Receptacle.

This Receptacle is seated under the Caliack and Emulgent Arteries, near the Lumbarry Vertebres, between the Tendons of the Midriff, or rather its Fleishy Processes, almost in the middle region of the Loins between the *Psoas*, Kidneys, and Renal Glands, and doth not observe in all Animals the same situation, but in Bruits somewhat inclineth toward the left side.

In most Men this common Cistern is endued with one Cavity, but Learned *Bartholine* hath observed three, two greater leaning one upon another, and conjoynd to each other by the interposition of Lactæal Vessels, between the ascendent Trunk of the *Cava* and the *Aorta*, seated in an Angle, which the Emulgents make with the *Cava*: And the third Receptacle is lodged above the first near the Midriff, under its Appendix.

The Figure of
the common
Receptacle is
round and
somewhat de-
pressed.
The substance
of the Recep-
tacle.

For the most part the common Receptacle is beautified with a round flat-tish Figure, somewhat inclining toward an Oval, that it may be capable to entertain a larger proportion of Chyle and *Lympha*.

The substance of this common Cistern is Membranous in most Animals, as composed of a double Coat, of which the outward is propagated from the rim of the Belly; but in Man *Bartholine* saith it is Glandulous, (resembling the other Glands of the Mesentery) beset with many Milky Vessels.

The differ-
ence of this
Receptacle in
divers Per-
sons.

It is very different in divers Persons in reference to its magnitude, sometimes, when extended it filleth up the space between the *Psoas* and the Kidneys, and their Glands.

The Cavity is much enlarged when distended with a large proportion of Chyle and *Lympha*, and much lessened, as losing its size and roundness of Figure, when it groweth lank as destitute of Liquor. In Man the Cavity is much less than in Bruits, but its substance more solid and thick.

The use of the
common Re-
ceptacle.

The use of this common Cistern is very obvious, to give an entertainment to the Chyle and Lymphatick Liquor, which are imported by the Milky Vessels and Lymphaducts inserted into the inward Coat of the Receptacle.

The origen
and progress
of the Thora-
cick Ducts.

The Thoracick or great Lymphatick ducts arise out of the upper region of the common Receptacle immediately under the Diaphragm, about the middle of the Spine below the great Artery, and being covered with the *Pleura* (as a guard to them for the greater security of their thin Coats,) are reflected some-
what

what toward the right side of the Artery, wherein it is more conspicuous, when the Intestines, Mesentery, and the cut Midriff are removed toward the left side: From hence the Thoracick Ducts taking their ascent under the great Artery, do bend about the fifth and sixth Vertebre of the Thorax toward the left side, and then do climb up below the Intercoastal Veins and Arteries, under the *Pleura* and *Thymus* to the left Subclavian Vein, into which they do insert themselves near the place where the left Jugular Vein is implanted. And the Chyliferous and Thoracick Ducts do not discharge themselves by one large common passage, but with six or seven holes, which are covered in the inside of the Subclavian Vein with one broad Valve, (looking from the Shoulder toward the *Vena Cava*) whereupon the Rivulets of Chyle and *Lympha* have a free current out of the Chyliferous Ducts into the Subclavian Vein, and the course of the Chyle and *Lympha* as well as Blood, is intercepted toward the Thoracick Ducts.

These Vessels are double almost in their whole progress from the common Cistern to the Subclavian Vein, (unless near the region of the Heart) and are often united as by so many scales of a Ladder, wherein they have frequent Inosculation with each other, upon this account (as I humbly conceive) that they might have a mutual intercourse by transmission of Chyle mixed with *Lympha* from one Duct to the other, to prevent the Stagnation of the said Liquors, which are necessary for the support of Blood as its *Materia Substrata*.

The Thoracick Ducts are for the most part double.

Sometimes these large Thoracick Ducts ascending out of the common Receptacle and climbing up the sides of the Spine, are not only often united by cross branches importing soft white Liquor from one Trunk to the other, but do also Coalesce into one large Duct in the middle under the great Artery.

The union of Thoracick Ducts by cross Branches.

The Insertion of the Thoracick Ducts is commonly made into the left Subclavian Vein both in Man and other Animals, and is very rarely seen in the right Subclavian Vessel. Learned *Pecket* giveth an account of two Thoracick branches ascending with divers parallel branches, here and there conjoined in the middle way, and uniting themselves about the third Vertebre of the Back, and then observed them parted again; and after some space one Thoracick Duct made its ingress into the right, and the other into the left Subclavian Vein.

The Insertion of the Thoracick Ducts into the left Subclavian Vein, rarely into the right.

These Thoracick Ducts are inwardly furnished with many Valves, which are instituted by Nature to hinder the falling back of the ascending Chyle and *Lympha* toward the common Receptacle, which would frustrate the intent of Nature, which is to repair the decay of Blood by the immission of Chyle into the Subclavian Vein.

The Valves of the Thoracick Ducts.

The use of the Valves may be rendred manifest, by reason the Chyle contained in the Thoracick Ducts may be easily Impelled by Compression upward toward the Subclavian Vein, and cannot be forced downward toward the common Receptacle, unless the Valves be Lacerated by offering a great Violence unto them.

The use of the Valves relating to the Thoracick Ducts.

If any curious Person be desirous to see the Thoracick Ducts, which are hard to be discovered in Dissection, by reason they are covered with a transparent Coat, which easily escapeth our Eyes, and especially when the Ducts are void of Chyle, which is frequent many hours after the assumption of Aliment; whereupon the Milky humor is discharged into the Subclavian Vein, and then the Thoracick Vessels grow lank and not to be seen: So that I humbly conceive, the best way to find these Ducts lodged under the *Pleura* and great Artery, is to cut up a Dog four hours after he hath been plentifully fed,

The way to discover the Thoracick Ducts.

M m m m m m m m

and

and then the Chyle is passing through the Thoracick Ducts rendring them big, and obvious to our sight: And I conceive, they may be seen in well fed Men (after they have been Executed) upon a Dissection celebrated presently after they are dead. And sometimes they may be seen in Persons dead of Diseases, which have rendred Men thirsty and obnoxious to drink free Cups of various Liquors, making a quantity of Chyle, which being imparted to the Thoracick Ducts doth swell their Coats, and present them to the Eye upon Dissection not long after death.

And now I conceive it worthy our Pains to consider how the motion of the Chyle and *Lympha* is accomplished in the Thoracick Ducts.

The motion
of the Chyle.

The Chyle being first generated in the Stomach, is thence transmitted into the Intestines, and afterward received into Origens of the *Lactea*, by the Peristaltick motion of the Guts, and the Contraction of the Abdominal Muscles, squeezing the Chyle into the Milky Vessels, which import it through the Mesentery into the common Receptacle, (being lodged between the Processes of Diaphragm) Compressed when the Midriff is moved and brought toward a Plain, whereupon the Milky humor is Impelled farther and farther upward through the Thoracick Ducts, till it landeth in the Subclavian Vein. This ascent of the Chyle is much assisted by the Mechanism of the Ducts as furnished with Valves, which give way to the ascent of the Chyle upward, toward the Subclavian Vein, and give a check to its retrograde motion toward the common Receptacle.

An Experiment
proving
the ascent of
the Chyle
through the
Thoracick
Ducts.
The motion of
the Chyle is
much assisted
by the *Lym-
pha*.

The ascent of the Chyle and *Lympha* may be proved by this Experiment in the Dissection of living Animals, made good by putting a Ligature upon the Thoracick Ducts; whereupon they grow big with Chyle below the Ligature between it and the common Receptacle.

The motion of the Chyle is very much helped by the motion of the *Lympha*, derived partly from the Recrements of the Liquor, destilling out of the Terminations of the Nerves, and principally out of the extremities of the Arteries, inserted into the Glands of the Liver, Spleen, and other parts of the lower Apartment; So that the *Lympha* is Impelled in the Lymphæducts by the motion of the Intestines and Abdominal Muscles through the Mesentery into the common Receptacle, where it meeteth with the Chyle and diluteth it, and being in association with it, doth assist its motion through the Thoracick Ducts, as having a more constant and brisk ascent in greater proportion than that of the Chyle.

The Blood is
repaired by
the access of
Chyle up-
ward.

These Thoracick Chyliferous and Lymphatick Ducts are the only way by which the Chyle is transmitted into the Subclavian Vein, whereupon the decays of the Blood are repaired, by reason if the current of the Milky humor be intercepted, the Animal becometh famished, as Learned Dr. Lower my worthy Friend and Colleague hath experimentally demonstrated in his Treatise, styled *Transitus, & Transmutatio Chyli in sanguinem*, p. 206. Atq; *hac via sola & unica est, qua Chylus è Ventriculo & Intestinis in ipsum sanguinem & Cor infunditur; Verum quia nonnulli in eodem cum veteribus errore etiamnum versantur, venasq; mesaraicas Chylum ex Intestinis excipere confidenter statuunt, ipse ut de hac re certior fierem, seriam aliquando impendi operam, atq; non ino experimento tandem mihi constitit, totum Chyli penum nulla alia via, quam per ductus Chyliferos, in sanguinem infundi; si enim cursus ejus per vasa Thoracica impediatur, Animal qualicumq; cibo satiatum intra paucos dies fame penitus interibit; quod in duobus canibus, diverso licet modo expertus sum. Alterius enim Thorace dextri lateris intra duas costas inferiores aperto, digitum immisi & ungue velut in ferram resecto commune receptaculum tribus horis à pastu valde turgidum*

turgidum perfregi & laceravi, ut Chylo in cavitatem Thoracis exitu dato, transitus ejus in ductus Chyliferos penitus interciperetur, quo facto & consuto vulnere, Animal hoc quantum capere voluit, postea satiari; Cum autem intra paucos dies exspiraret, & à me statim diffecaretur, ventriculum & Intestina valde repleta, quia & Venas Lacteas Chyli plenas inveni, nihil autem ejus in toto ductu Thoracico apparuit, verum in eo pectoris latere, in quod commune Receptaculum disruptum est, duæ libræ Chyli repertæ sunt; unde certo constare arbitror ob perperditum Chyli per ductus Thoracicos transitum Animal hoc ventriculo licet cibus referto utcumq; fame perisse.

This Learned Author doth farther Illustrate the motion of the Chyle blended with *Lympha* in the Thoracick Ducts by another Ingenious Experiment, by making an Apertion in the left side between the third and fourth upper Ribs, in which region the Chyliferous Vessels do commonly meet in one Trunk, which leaneth over against the Guler upon one of the Muscles, and passeth under the *Pleura* toward the Subclavian Vein; So that a Finger being immitted through an Orifice of the wound, did Lacerate the tender wall of the Duct whereupon the Chyle was Exonerated into the cavity of the *Thorax*, and could by no means insinuate it self into the Subclavian Vein: The wound being sowed up, and the Dog though well, fed for some days, grew faint and died; and afterward the *Thorax* being opened, was found full of Chyle. And to give a farther Demonstration of the progress of the Milky Juice through the proper Vessels of the *Thorax*, an Injection was made below into the Thoracick Duct, and the Liquor was found to discharge it self through the wounded Ducts, and was wholly lodged in the cavity of the *Thorax*, as not being capable to make its way into the Subclavian Vein.

And a wound being made in the left side of the *Thorax* between the third and fourth upper Ribs, and a strong Compression made of the Thoracick Duct for an hour or more, the Chyle cannot insinuate it self through the Terminations of the Chyliferous Vessels into the Subclavian Vein, whereupon the passage of the Milky humor being intercepted above, is forced to make a retrograde current downward into the common Receptacle and Lacteal Vessels of the Mesentery, which is a pleasant sight to behold.

Another Experiment proving the motion of the Chyle.

C H A P. II.

Of the Midriff.

HAVING given you a prospect of the parts of the lowest Venter at large in the former Book, I will now contract them into a more narrow Model, and shew you how they are subservient to the *Viscera* of the middle Apartment, with which I design hereafter to entertain you Part by Part according to the same Method, as Nature hath instituted them.

The Fabrick
of Man's body.

The goodly structure of Man's body may be styled the Master-piece of Nature's Architecture, as beautified with a comely Figure, and composed of variety of Parts, set together in excellent order, and compiled of three Stories, standing upright one above another.

The walls and
household-stuff
of the lowest
Apartment.

I have given an History of the Lowest, encircled with the four common Coverings, as so many Out-buildings, and decked more inwardly with the rare expansions of the rim of the Belly, and Caul, immuring within their soft embraces the tender Bowels, as so many choice Utensils furnishing the lowest Apartment; The Aliment is prepared with divers Ferments, as so many *Menstrua* in the cavity of the Stomach, as in a Retort, whereby a Milky Tincture is extracted by the gentle heat of the neighbouring parts, *tanquam Balneo Mariae*, and is imparted to the Intestines, as so many Recipients, wherein it is farther concocted by new Ferments, and is afterward transmitted into the Mesenterick Lacteal Vessels, while the *Magma* or grosser reliques of the concocted Aliment, are conveyed through the Membranous Tubes of the Intestines in order to Expulsion.

The use of the
Liver.

The Spleen prepareth a ferment for the Liver in reference to the Secretion of Bile from the Blood; and the Liver, *Pancreas*, and Kidneys, are so many Colatories of the Vital Juice, and thereupon are attended with the bladder of Gall, and Urine, as Receptacles to entertain Biliary and Serous Recrements.

The lowest Apartment is ministerial to the middle, as it prepareth and transmitteth to it a Milky Extract (the *Materia Substrata* of Blood) by the Thoracick Ducts.

The Integuments
of the middle
Story
of Man's body.

Thus having given you a short Narrative of the select Household stuff of the lowest Story, with your permission, I will take the freedom to Treat you with a sight of the more noble furniture of the middle Apartment, outwardly encompassed with four universal Coverings as so many fine walls, and more inwardly behind with the *Musculus latissimus & longissimus dorsi*, *sacro-lumbares*, *semi-spinati*, *serrati postici superiores & inferiores*, supported with a Column made up with many Vertebres of the Back, finely Carved with acute, oblique and transverse Processes: And this Story is encircled on each side with twelve Ribs, as so many bony Arches, interspersed with intercostal Muscles; and is guarded before with the *Musculus pectoralis*, *serratus anticus major & minor*, and more firmly with the Sternon, as with a strong Breast-plate.

The furniture
of the middle
Story.

The middle Venter is closed below with the Midriff as with a Floor, ended in its repose with a concave Surface toward the lowest Apartment, and with a Convex toward the middle, and with a kind of Plain in its Contraction,

tion, and is seated above with the biggest Ribs and Clavicles, and adorned within with the thin wall of the Mediastine (parting the middle Apartment into two Allodgments) and with the fine hanging of the *Pleura*, enveloping the excellent Utenfils of the middle Story, the Heart and Lungs, the various Machines of the motion of Blood and Air.

In the lowest Venter the Milky Extract is prepared out of Aliment as associated with various ferments of the Stomach, and Intestines, and is thence conveyed through the Mesentery and *Thorax* by proper Milky vessels, into the Subclavian Veins, and by branches of the *Carva* into the Heart, and broken into small Particles against the wall of its right Chamber; And the Chyme mixed with the Blood is receptive of a farther comminution, as it is transmitted into the substance of the *Bronchia* and *sinus* of the Lungs, where it meets and confederates with the Nitrous and Elastick Particles of Air, opening the Compage of the Blood and Chyme, and converts its purer Particles into Vital Liquor, which receives more and more perfect Assimilation while it circulates farther, and converses more with the Blood in its motion through the Arteries.

Thus having given a short Account in general of the Utenfils relating to the middle Apartment, I will endeavour now to give a more particular description of them, beginning with the Midriff, as the first in order.

The useful Machine of Motion may be offered to our Consideration under divers Notions, in reference to Situation, Connexion, Figure, Compage and Use.

The Midriff is called by the Greeks, *μεσεντεριον*, *ἐσθν*, *διαφραγμα*, *διαπεσχυμα*, &c. by the Latines, *septum transversum*, *præcordia*, and is seated in the lower region of the middle Apartment as a Floor closing its circular Aperture, and is a part of the *Thorax*, as it assisteth respiration by its contraction, and serveth as a party-wall † to sever the Middle from the lowest Story: And hath its Connexion behind by the mediation of two Carnous Processes, interspersed with many tendinous Fibres inserted into the lower Vertebres of the Back and upper of the Loins: These Fibres being propagated from the Membranous Circle of the Diaphragm do pass transversely to the Vertebres of the Spine (and accompany for some space the great Artery) adhering to the Muscles of the Loins, and growing less by degrees do creep under the Trunk of the *Aorta*, till they find the Vertebres void of Flesh, and then are most strongly inserted into them. The Diaphragm also is firmly fastned by many Tendinous Fibres both above and below to the extremities of the bastard Ribs, and to the inside of the Sternon, which defends the exterior confines of this soft moving engine as with a Wall; and the Midriff is not only inserted into the Cartilage of the twelfth Rib, but is fastned according to its fleshy margent by the interposition of Fibres to the circular Termination of the Ribs, and to the oblique, ascendent, and transverse abdominal Muscles.

This fine Organ of Motion is beautified with a circular Figure †, and is carried round in an oblique posture from the Vertebres of the Back and Loins, all along the confines of the lowest Ribs to their Cartilaginous Extremities, and the inward region of the Sternon, and hath not only one orbicular Figure seated in its fleshy circumference, but another Nervous kind of smaller Circle placed within the other, and if it be curiously inspected, it cannot be called a true Circle by reason it is more expanded in its Origen, and terminates after a manner into an acute Angle.

The situation
of the Midriff.

† T. i. q. q. q.
The Connexion
of the Midriff.

† T. i. q. q. q.
The circular
Figure of the
Midriff.

The Compage
of the Midriff.

As to its Fabrick, it may be styled a Compage, made up of Membranes, Arteries, Veins, Nerves, Carnous and Tendinous Fibres finely interspersed with each other.

The upper
Membrane.

The Diaphragm is composed of a double Membrane, the uppermost facing the middle Apartiment, may duly claim its birth or origen from the *Pleura*, and is a Texture finely wrought with variety of small membranous Filaments intermingled with Nervous.

The lower
Membrane.

The lower Membrane is somewhat more thick than the other, and borroweth its rise from the rim of the Belly, and framed of divers Membranous, Nervous and Tendinous Fibres (running in various positions) finely spun, and closely struck, and curiously interwoven; So that they seem to make an entire piece, which fronteth the upper region of the lowest Apartiment.

The Flefhy Fi-
bres of the
Midriff.

The Midriff hath also many Flefhy Fibres, which impart motion to it, and thereby enlarge the inward Perimeter of the *Thorax* in order to give reception to the expanded Lungs in inspiration: These Fibres beset the Circumference, and give it a red hue, and render it more thick about its confines, and in its Center, or white expansion; it is furnished with many Tendinous Fibres which are main Integrals constituting the beginning, as some will have it; or the Termination or Tendon of this Muscle, as others imagine; The Tendinous Fibres pass through the Center to the Circumference, as so many Rays, and about the Foramen (enclosing the Origen or left Orifice of the Stomach) are seated many Circular Fibres, which being convulsed, do cramp the beginning of the Ventricle with repeated Gicks, vulgarly called Hiccops.

The Tendi-
nous Fibres.

The various
Vessels of the
Midriff.

The Veins.

The Diaphragm is also accommodated with variety of Vessels, two Arterial branches, styled Phrenick, which are derived from the great descendent Trunk of the *Aorta*, and do shade the Coats of the Midriff with numerous great and smaller Divarications, which are accompanied with many Venal branches, (having the same appellative with the Arteries) and export Blood from the Diaphragm toward the *Cava* to make good the circulation of Vital Liquor hastning to the right Ventricle of the Heart.

The Nerves.

This circular Muscle, different in figure and way of motion, is endued with many Nerves, derived from the Rowl, relating to the Neck, and from divers vertebral Branches, as also from the *par vagum*, which are propagated through the whole substance of this part, as being very considerable in the Tunicles and Center of it, as being Nervous, and of a most acute Sensation.

The three
Perforations
of the Midriff.

It is endued with three Perforations; The first, according to Learned *Vesalius*, receiveth the great Artery and Nerves of the *par vagum*, passing into the Liver, Spleen, Kidneys, Intestines. The second Foramen, inclining toward the right side, is seated about the Tendinous part, and giveth admission to the ascendendent Trunk of the *Cava* in its ascent toward the right Ventricle of the Heart. The third Foramen of the Midriff bendeth toward the left side to give reception to the *Oesopaghus*, or rather Origen of the Stomach with some Nerves of the *par vagum*, implanted into it.

The Midriff is
a double Mus-
cle, according
to *Bartholine*.
The upper
Muscle.

Learned *Casparus Bartholinus*, pleaseth himself very much in a new discovery of the Diaphragm to be compounded of two Muscles, adorned with a Semicircular Figure; The upper is fastned in one Extremity to the bastard Ribs, and the other is implanted into the *Aponenrosis*, making the Center of the Midriff, composed of divers tendinous Fibres (besetting the upper and lower Membrane) in which the Midriff somewhat resembleth the Digastrick Muscle,

Muscle, as having a Nervous expansion or body, interceding the Carnous Circumference, as Learned *Steno* imagineth.

The lower Muscle (as the Learned Author supposeth) taketh its rise from the Vertebres of the Loins, and doth not come from the other, nor touch it, only by the interposition of the *Aponéurosis*, in which the Tendons of both Muscles do intermingle.

The lower Muscle.

One Argument by which the Author endeavoureth to prove the Midriff to be a double Muscle, is, because the lower is furnished with proper Blood-vessels and Nerves, and hath Veins not only from the *Cava*, the same with the upper Muscle, but Lateral branches (that discharge themselves into the Adipose Vein) which are accompanied with Arteries, derived from the Loins.

And the lower Muscle in its upper region is encompassed with circular Fibres, running round the Perforation of the Midriff entertaining the origen of the Stomach, in which a Hiccup is made by the Convulsive motions of the diaffected Fleshy Fibres

The upper Muscle (saith he) is accommodated in its circumference with many Carnous Fibres coming from every Rib (which seem to be so many origins of distinct Muscles.

The Carnous Fibres of the upper Muscle.

The plain of the ranks of Fibres (called by him *inaequaliter aequales*) is seated in the interior region of the upper Muscle, where the Tendon is implanted into the Ribs: And the Tendon of the lower Muscle maketh the Center of the Diaphragm, and the Parallelogramms of Fleshy Fibres are sometimes attended with Tendinous, and other times with Carnous sides; This simple Muscle may be called the Shorter Diagonal, as it maketh obtuse Angles with the Tendinous sides, by reason the longer Diagonal maketh acute Angles with the said sides.

And the lower Muscle of the Midriff hath almost the same fabrick with the upper, and different in this, that the distance of the ranks interceding the Carnous sides, is somewhat greater in the lower than in the upper Muscle; and the ranks observe the same distance in both Muscles in reference to their Tendinous sides.

The frame of the lower Muscle is almost the same with the upper.

The lower Muscle is made up of many Carnous Fibres running in right lines, which coming out the right and left circumference, are implanted into the Tendinous center of the Midriff.

The Carnous Fibres of the lower Muscle.

In Beasts and other greater Animals (in which all parts of Nature are very conspicuous by reason of their eminent greatness) the Lateral Region of the Diaphragm may be seen, to be fastned not to the Sternon but Ribs, and at each of them an Elongation of a Fibre may be discovered, which is continued with the upper part of the transverse Muscle, relating to the Abdomen; whereupon I humbly conceive that this Abdominal Muscle hath great affinity with that of the Midriff; So that there may be a kind of Trigastrick Muscle (as Learned *Bartholine* will have it) composed of three Carnous Venters, of the inferior and superior Muscle of the Diaphragm, and a third of the transverse Abdominal Muscle, between which divers Tendinous Fibres intercede, which constitute a considerable part of the Center belonging to the Diaphragm: This renowned Author giveth a farther account of the Trigastrick Muscle in point of its use:

The Lateral region of the Diaphragm is fastned to the Ribs.

The Trigastrick Muscle.

Ait ille; In hac cum Costis annexione magnum latet Naturæ Mysterium: Quia Costæ in inspiratione ubi pectus dilatabitur sursum trahi debent, quo tempore etiam relaxantur carnes Trigastrici, & Diaphragma interea incurvato magis planum, & relaxatum, atq; in Abdomen protrusum, Costas, pro dilatatione pectoris, non nihil attolli & Elongari finit. By the leave of this Famous Author, I humbly

con-

The transverse Abdominal Muscles are Antagonists to the Midriff.

conceive, That the transverse Muscles of the *Abdomen* being part of the *Trigastrick*, do not assist the *Diaphragm* in bringing its Concave Surface toward a Plain (in which the Fibres of the *Midriff* are rendered Tense and not Relaxed) by reason the transverse Muscles are Antagonists to the *Diaphragm*, and by compressing the *Abdomen* do force the *Viscera* upward, and relax the *Midriff* in reducing its more plain Surface to a Concave, in order to Expiration.

Having given you a sight of the structure of the *Diaphragm*, I will now present you with the action and uses of it.

The *Diaphragm* hath not a double motion, as *Pecket* would have it.

Learned *Pecket* affirmeth it to have a double motion; So that the lower Mediety adjoining to the Vertebres of the Loins and Back, is depressed by the Flethy Fibres relating to the hinder Semicircular part, and at the same time the anterior Segment of the *Midriff* fastned to the Sternon and bastard Ribs, is lifted up by the neighbouring Carnous Fibres; But the Sentiments of this Famous Author seem very strange, as disagreeable to Ocular Demonstration, because in the Dissection of living Animals both the posterior and anterior Semicircles of the *Midriff*, may be clearly discerned to move downward at the same time, in being brought nearer to a Plain, by reason the whole Perimeter of the *Diaphragm* is tied behind by the Carnous productions interspersed with many Tendinous Fibres to the lower Vertebres of the Back, and to the upper of the Loins, and on each side to the margents of the eleventh and twelfth Ribs, and before to the Sternon and Cartilages of the bastard Ribs, and in its Center to the *Mediaستine* and *Pericardium*; whereupon when this Orbicular Muscle doth exert its motion, it contracteth the lower and upper Fibrous Diameters, or Semicircles; So that the pliable Cartilaginous Terminations of the bastard Ribs are drawn downward, and Concave Nervous Center is depressed toward the lowest Apartment, and its *Viscera* forced downward; whereupon the Cylinder of the Breast is lengthened, and its bosom enlarged to give reception to the distended Lungs in Inspiration.

The Systole of the *Diaphragm* in Inspiration.

The Diastole of the *Midriff* in Expiration.

But on the other side, the *Midriff* in Expiration hath a Diastole, as freed from Motion by the relaxation of its Flethy Fibres (seated in the circumference of the *Diaphragm*) performed by the Abdominal Muscles as Antagonists, which by forcing the anterior part and sides of the *Abdomen* inward, do force the *Viscera* of the lowest Venter upward toward the *Thorax*, whereupon the Center of the *Midriff* loseth its Plain, as lifted up toward the Heart and Lungs, whence the Perimeter of the *Thorax* is lessened to comply with the lank condition of the Lungs, when despoiled in a great proportion of the Nitrous and Elastick parts of Air, squeezed out in Expiration.

CHAP.

C H A P. III.

The Pathology of the Midriff and its Cures.

THe Midriff is taken with an Inflammatory Disease, proceeding from an exuberant quantity of Blood, carried out of the descendent Trunk of the *Aorta*, and through the Terminations of the Phrenick Arteries into the substance of the Diaphragm, whereupon it is Tumefied, by reason the Blood is so great in quantity, or so gross in quality, that the minute extremities of the Phrenick Veins are not capable to receive it.

The Inflammation of the Midriff.

This Disease is accompanied with a continued acute Fever, attended with a difficulty of Respiration, and much pain; and afterward if this inflammatory malady prevail, the Brain is drawn into Consent, whereupon it is called *Paraphrenites*, because the center of the Diaphragm is Nervous, as also its Membranes are interspersed with many filaments of Nerves; whence ariseth a *Delirium*, sometimes associated with Convulsive motions.

The Inflammation is associated with a continued Fever.

As to the Prognosticks of this Disease, they speak great danger, as the Diaphragm is highly disaffected, which is a necessary Organ of Respiration, conducive to the preservation of life.

The Prognosticks of an Inflammation of the Midriff.

This Disease as founded in a quantity of Blood (settled in the Interstices of the Blood-vessels, relating to the Diaphragm) doth denote Blood-letting, to divert the current of Blood from the part affected, also to lessen its quantity, and to make good its Circulation.

Blood-letting is good in an Inflammation of the Midriff.

And in reference to the acute Fever attending this Disease, cooling Julapes and Apozemes may be very proper (given with Testaceous Powders of Crabs Claws, Pearl, &c.) which attemper the Blood, and gently promote Sweat; and in point of a farther method of Cure, I refer you to a Pleurisie, *Peripneumonia*, and other Internal Inflammations.

The Diaphragm is highly disordered by wounds, made in the Fleishy, and chiefly in the Tendinous part, as made up of many Nerves, often producing a *Delirium*, attended with a Sensation of weight, caused by the wounded Tendinous Fibres, hindring the free play of the Diaphragm; whereupon ariseth a great difficulty of breathing, and high pain and Cough, wherein sometimes the Stomach and some part of the Intestines are forced through the Perforation of the Midriff into the Cavity of the Thorax. Of this case Learned *Paræus* giveth two Instances, *Lib. nono, Cap. trigessimio de Vulneribus Thoracis. p. 308. Cum Diaphragma vulneratum est, ponderis sensus eo loci molestus est, Delirium invadit per nervorum, qui à sexta Conjugatione in Diaphragma effunduntur, sympathiam, Dyspnœa, tussis & dolor acutus ægrum male habent, sursum ilia convelluntur, adeo ut inspirationis vehementia contingat aliquando Ventrículum & Intestina per vulnus in Thoracis capacitatem pertrahi: Quod ego in duobus observavi. Horum unus latomus medium Diaphragma qua parte Nervosum est transfixus, triduo post interiit. Dissecto ventre inferiorem ventriculum cum non reperirem, rem Monstri similem arbitrabor. Sed tandem anxie perquirens, raptum ipsum in Thoracem Animadverti, etsi vulnus pollicem vix esset latum. Erat vero ventriculus paucum admodum humore distentus.*

The wounds of the Diaphragm.

Alter *Franciscus Dalon* dicebatur, *Capitaneus Saxto. Huic ad Rupellam Glans manuuario tormento emissa, per sterni fines juxta Xyphoidem Cartilaginem*

O o o o o o o o

subi-

subiens, Diaphragmatis partem carneam transfodit: Atq; per Interstitium quod quinta & sexta Costæ nothis interjacet, Excessit: Vulnere parte externa Cicatrice obducto, restabat ipsi nihilominus ventriculi debilitas, ex quo Intestinorum dolor Colico similis sub vesperam & de nocte præsertim exurgebat: qua de causa Canare ipse nisi admodum parce non audebat. Sed octavo demum Mense Acrius solito sæviente per inum ventrem dolore, è vivis excessit, etsi ad minuendam doloris acerbicatem nullum remedii genus à Simone Malmadrano & Antonio Vallensi Medicis, in omni Medicinæ parte versatissimis, qui ipsi aderant, esset prætermisum. Mortui Cadaver Jacobi Guillemean Chyrurgi peritissimi manu Dissectum est, animadversumq; magnam Coli Intestini partem flatu multo turgidam, ipsi per Diaphragmatis vulnus in Thoracem irrupisse, vulneris tamen amplitudo vix minimi digiti Capax erat.

CHAP. IV.

Of the Midriff of greater and less Animals.

The Midriff of other Animals is much akin to that of Man's.

THE Midriff of greater and less Animals have much affinity in Situation, Connexion, Figure, Substance, with that of Man's, *vid.* In Lions, Elephants, Bears, Horses, Mules, Sheep, Goats, Tygres, Wolves, Foxes, &c.

The situation of the Midriff.

The Midriff in these Animals is situated between the middle and lowest Apartment, by whose interposition they are parted from each other, as by a wall. It is Connected behind by the mediation of two Carnous Processes, interspersed with many Tendinous Fibres, implanted into the lower Vertebres of the Back, and upper of the Loins, and is firmly affixed before by many Tendinous Fibres both above and below into the Terminations of the bastard Ribs, and to the inside of the Sternon, and according to its Flethy margent by the mediation of Fibres to the circumference of the lower Ribs.

The figure of the Midriff.

The Midriff of other Animals as well as that of Man, is beautified with a circular figure, as it maketh an oblique progress from the Vertebres of the Back and Loins, all along the Perimeter of the lowest Ribs to their grisly Terminations, and within this greater Carnous circumference is seated, as *Vesalius* will have it, another lesser Membranous Circle, but in truth it is made up of divers Angles.

The Membranes of the Midriff.

And the Midriff in Beasts of various kinds, hath the same substance with that of Man's, as composed of two Membranes interspersed with Carnous and Membranous Fibres, and great variety of Blood-vessels.

The Midriff of a Tortoise.

The Midriff of a Land Tortoise, is very remarkable in reference to its Contexture and Situation, as to the first it seemeth to be a Membranous Expansion, as viewed by a careless Eye, but upon a more curious inspection, it is found to be furnished with many fine Flethy Fibres; and it's very eminent for its situation, which is different from other Animals, as being more elevated

vated in the hinder parts, contrary to that of Man, Beasts, and more perfect Animals, which is lower in the Loins, and higher about the Cartilages of the Ribs.

The Diaphragm in this Animal ascendeth obliquely from the lower part of the Breast, and is first Connected firmly to the sides, and then to the Back, (where it is most highly seated) by the interposition of Ligaments and Flethy Fibres.

The Midriff in this Animal is different also from others, by reason it is not an Intersepiment, parting the *Viscera* of the middle Apartment from the lowest; so that a great part of the Lungs Perforate the Midriff, and are lodged in the *Abdomen*, passing down to the lowest part of it, as I saw it in a dissected Tortoise, when the Lungs were blown up, and were affixed to the lower region of the *Abdomen*, and the Midriff in this Animal is fastned in some part above to the *Pericardium*, and below to the bladder of Urine, from which it can scarce be parted without Laceration.

The Midriff of a Crocodile, is a very thin Membranous expansion, composed of many fine Fibres, curiously framed and interwoven, and seemeth to resemble a Spiders Web in thinness, and is furnished with many minute Carnous Fibres, as rare Engines of Motion.

The Midriff of Castors, Otters, Cats, &c. have the same structure with those of greater Animals, and are composed of Flethy and Tendinous Fibres, covered with thin Membranes.

A Mouse hath a very thin Diaphragm, as composed of fine Membranes (interspersed with small Tendinous and Carnous Fibres) whereupon it is transparent in the Center, and more opaque toward the circumference; and is endued with an oblong roundish figure.

Vipers, Lizards, Frogs, Toads, have no Diaphragm parting the middle from the lower Apartment; So that these Animals have but one Venter, in which the Heart, Lungs, and other *Viscera* are lodged.

The Midriff
of a Croco-
dyle.

The Midriff of
Castors, Ot-
ters, &c.

The Midriff of
a Mouse.

CHAP. V.

Of the Midriff of Birds.

The Mem-
brane adjacent
to the Lungs,
supplieth the
defect of a
Midriff in
Birds.

Although Birds having their Lungs affixed to their Backs and Ribs, are not endued with a Diaphragm, like a wall in other Creatures severing the Heart and Lungs from the *Viscera* of the Venter; yet they have a Membrane adjoyning to the Lungs, which separates them from the Guts and other *Viscera*, and upon that account may be styled a kind of Midriff, as endued with Membranes and fleshy Fibres (coming as I conceive from the Intercoastal Muscles) which may be plainly discovered in great Birds, as Estriges, Swans, and the like.

This Mem-
brane is beset
with Carnous
Fibres, and is
Distended in
Inspiration.

This Membrane parting the Lungs from the other *Viscera*, may challenge to it self the Appellative of a Diaphragm, as being beset with many Carnous Fibres, assisting the respiration of the Lungs, which being Perforated, do transmit Air into the empty space, interceding the Lungs and the neighbouring Membrane, whereupon it groweth distended by the impulse of the Breath expanding it in Inspiration.

This Mem-
brane endea-
voureth to re-
duce it self to
a Plain in Ex-
piration.

And in Expiration, the tender Compage of the adjacent Membrane is Dilated by inspired Air, with which it being Irritated, doth endeavour to bring it self to a Plain by the motion of its Fleshy Fibres, whereupon it lesseneth the Cavity, passing between the Lungs and the adjacent Membrane, and Compresseth the inspired Air, and Repelleth it through the Perforations into the substance of the Lungs.

The difference
of this Mem-
brane from
the Midriff of
other Ani-
mals, as ha-
ving a differ-
ent Figure and
Situation.

This Membrane differeth from the Midriff of other Animals, in its situation, and connexion, and passeth longways down the *Abdomen*, and not transversely, as from the Back to the termination of the Ribs, as in greater Animals.

Secondly, This Membrane hath a different Figure from the Diaphragm of other Animals, as it is affected, when relaxed with a Concave Figure to the Lungs, and Convex to the Intestines; whereas the Diaphragm of other Animals, in its posture of restitution hath its Concave Surface, facing the *Viscera* of the lowest Venter, and its Covex toward those of the middle.

The Cavity of
the Breast is
not made
more large in
Inspiration by
this Mem-
brane.

Farthermore this Membrane doth not enlarge the Perimeter of the Breast in length, as the Midriff of other Animals doth in Inspiration, to give reception to the Lungs, Dilated with Air; but when this Membrane is moved with fleshy Fibres, doth narrow the Cavity of the *Abdomen*, and help Expiration by beating the Air backward (brought in by Inspiration) through holes into the body of the Lungs.

C H A P. VI.

Of the Midriff of Fish.

THe Midriff of Cetaceous Fish differeth very much from that of other, as it is an Engine of Motion, consisting of Carnous and Tendinous Fibres, enlarging the circumference of the *Thorax* in dimensions, by bringing its Concave Surface to a Plain, to entertain the Lungs Dilated with the Elastick Particles of Air, puffing up their substance.

The Midriff of ordinary Fish is not capable of motion, as being a Cartilaginous substance or Membranous Contexture, not interspersed with Flethy and Tendinous Fibres, the fine Machines of Motion, whereby the Diaphragm of most Fish serveth only as an Intersepiment to part the Gills and Heart from the *Viscera* reposed in the lowest apartment of the Body.

But the Midriff of a Porpess is made up of an upper and lower Membrane, interlined every way with a thick Muscular Expansion, and differeth from the Diaphragm of Quadrupeds, because it is destitute of an *Aponeurosis* in the middle, where it is also Flethy, as well as in the circumference, which I clearly saw in a Porpess opened, wherein I separated the two Membranes from the inward Flethy substance; passing every where between the two Coats.

The Diaphragm of this Animal is fastned one way to the Vertebres of the Back, and on the other to the Terminations of the Ribs and Sternon, and on each side to the Arches of the lower Ribs, by the interposition of various Fibres.

The Muscular Expansion seated in the middle of two Membranous Integuments, is made up for the most part of right Fibres, (running from the Center to the Circumference) and some few seem to be oblique, and others circular about the Perforation made by the Gullet:

The Midriff of a Porpess is not only beset with many Flethy Fibres but Tendinous too; some being very large do pass down the Spine, and others creep over the *Psoas*, and many other smaller Tendinous Fibres are intermingled with the Flethy, which may be discerned on each side of the Diaphragm.

The Flethy and Tendinous Compag of this Orbicular Muscle is invested above and below with a fine Covering.

The outward or rather upper Tunicle, is very thin, and made up of many minute Membranous Filaments rarely framed in variety of Positions.

The lower Integument is a thicker Coat, made up of many Nervous Fibrils, finely spun, closely struck, and curiously interwoven.

The use of the Midriff in this Animal, is the same with that of Man and Quadrupeds, to be a machine of Motion, whereby it bringeth it self from an Arch toward a Plain, to render the Cavity of the *Thorax* more long to give way to the expanded Lungs in Inspiration.

The Midriff of most if not all Fish, except those of a Cetaceous kind, have a Cartilaginous (which is rare) or Membranous substance not interlined with a Muscular Expansion, nor beset with Flethy and Tendinous Fibres, as they are not Machines of ordinary Motion, but serve only as a party-wall, severing the middle from the lowest apartment.

The Midriff of ordinary Fish is immovable.

The Compag of the Midriff of a Porpess.

The connexion of the Diaphragm in a Porpess.

The Fibres of the Diaphragm of a Porpess.

The upper Tunicle of the Midriff.
The lower Coat of the Diaphragm.

The use of the Midriff in this Animal.

The Midriff in Fish is sometimes Cartilaginous, and for the most part Membranous.

P P P P P P P P

A Fire.

A Fire-flaire
hath a Carti-
laginous Dia-
phragm.

A Fire-flaire, or Sting-Ray, is so called from a Bone composed of many Processes or Teeth, (received into many Cavities near the Spine) with which Nature hath armed this Fish against outward assaults.

This Fish hath a Cartilaginous Diaphragm, having a Concave Surface toward the lower Venter, and Convex toward the Mouth and Heart.

The Midriff of
a Dogfish.

The Midriff of a Dog-fish is a Membranous Compag, composed of two Coats, and is endued with a Concave Surface toward the Mouth and middle Apartment, and a Convex toward the lowest Venter.

CHAP. VII.

Of the Pleura.

The situation
of the Pleura.

THe *Pleura* is called by the Latines, *Membrana Costas Succingens*, as encircling the Ribs, and by the Greeks, *μενβρα*; This Membrane investeth the whole company of Ribs, except the twelfth, which is taken up with the Midriff; and it enloseth the Vertebres of the Back, and the upper Surface of the Midriff, and is extended in the hinder region of the *Thorax* from its first to its eleventh Vertebre, and in the fore part lineth the inside of the Sternon from the upper region to its lower part, where the Diaphragm is implanted.

The figure of
the Pleura.

The figure of the *Pleura* is like that of the inside of the *Thorax*, as it every where lineth it, and upon that account holdeth Conformity in shape to the inward circumference of the *Thorax*, whereupon the *Pleura* is endued with great variety of Figures; in its upper region it is more narrow, and more enlarged toward the Midriff, and obtaineth a greater shortness in the fore part, than in the hinder; and passeth in an oblique position from the Sword-like Cartilage to the eleventh Vertebre of the *Thorax*.

The connexi-
on of the Pleu-
ra.

This useful Membrane hath a connexion with divers adjacent parts, the Intercoastal Muscles, Ribs, Sternon, and Vertebres of the Back, to which it firmly adhereth, not immediately, but by the interposition of the *Periostium*, relating to the Ribs and Vertebres of the Back.

The *Pleura* hath its inward Surface smooth toward the Lungs, anointed with unctuous Matter, and its outward full of Asperities, as it admitteth a connexion with variety of neighbouring parts.

This tender part is made up of a double Membrane, which is most conspicuous about the Vertebres of the Back and the Mediastine, which is a Duplication of the *Pleura*.

The outward
and inward
Membrane of
the Pleura.

The outward Membrane is more thick and strong (as consisting of greater Fibres,) and the more inward, more thin and tender.

The fine Contexture of these Coats is made up of numerous well spun Fibres, of which some are right, others tranverse and oblique, and are all so closely struck and so curiously interwoven, that their Interstices cannot be discerned; so that this part, composed of many Filaments, seemeth to be one entire substance.

It emitteth many Membranous Processes or Nervous Fibres, as Learned *Diemerbroeck* will have it; by which the *Pleura* is tied sometimes to the Lungs,

Lungs after a Lax position; so that this connexion giving a free play to the Lungs, doth not hinder Respiration.

The *Pleura* is not only framed of a great company of Fibres running in several postures, but hath a *Parenchyma* too (interlining and filling up the Interstices of the Filaments) which proceedeth (as I humbly conceive) from the *Succus Nutricius*, or Seminal Liquor, accreted to the sides of the Fibrils in their first formation.

The Fibres
and Parenchy-
ma of the
Pleura.

The *Parenchyma* of this, as well as all other Membranes, is of great use, in reference it filleth up the vacuities of the Fibrils, and giveth an evenness and smoothness to the Coats of the *Pleura*.

The use of the
Parenchyma of
the *Pleura*.

This fine part is Perforated in many places in order to the passage of the *Vena Cava*, *Aorta*, *Aspera Arteria*, Thoracick Ducts, Lymphaducts, Gullet, and the *par vagum* of Nerves.

The Perfora-
tions of the
Pleura.

It is adorned with many Divarications of divers kinds of Vessels, Veins, a *Vena sine pari*, and the upper Intercostal Branch; and Arteries from the Trunk of the *Arteria Magna*, and from the Intercostal Branch and twelve pair of Nerves from the Vertebres of the Back.

The Vessels of
the *Pleura*.

The *Pleura* hath two uses, The first is to propagate Coats to the Heart, Lungs, Sternon, Ribs, and all parts contained in the *Thorax*, as the *Peritoneum* doth to the Stomach, Spleen, Liver, Kidneys, Intestines, and all parts of the lower Apartment.

The first use
of the *Pleura*.

The second use of it (as I conceive) is by encircling the inward circumference of the *Thorax* with a soft Vail to secure the *viscera* of the middle story of the Body, the Heart, and Lungs, from dashing in their motion against the more hard walls of the Sternon, Ribs, and Vertebres of the Back.

The second
use of the
Pleura.

The *Pleura* ariseth from the bones of the Back, from which on each side of the *Thorax* it climbeth up to the Sternon, under which the Membrane of each side is conjoyned, and so being doubled (which is called the *Media-stine*) is carried through the middle of the *Thorax* straight toward the Back, and parteth like a wall the Lungs and the Cavity of the middle Apartment into two Allodgments. This conjunction of the Membranes of each side, constituting the *Media-stine*, is rendred conspicuous in Dissection, when the Sternon is parted from the Ribs, and turned up.

The origen of
the *Pleura*.

The *Media-stine* is much akin in structure, to the *Pleura*, as being a Duplication of it, and hath its Coats more soft and thin toward the Lungs.

The *Media-
stine* is a Du-
plication of
the *Pleura*.
The Compag-
e of the *Me-
dia-stine*.

The Texture of it hath much likeness to that of the *Pleura*, as composed of many Fibrils, taking their progress in variety of Postures, whose empty spaces are filled up with a *Succus Nutricius*, or rather Genital Liquor in its first production, and is nothing else but a continuation or elongation of the Coats of the *Pleura*; passing through the middle of the *Thorax*, by which it is divided as by a Partition into two Chambers.

Learned Dr. *Highmore*, is of an opinion, that the *Thorax* hath an empty space running about the Sternon. The Author's words are these, *Non obscure duplex Mediastinum est, ut Pleura, sed conspicue, ut tantum intercedat spatium, quanta est Sterni latitudo. In Canibus juxta Diaphragma tanto à se invicem separantur, ut pro quinto Pulmonum lobo in hominibus desiderato, spatium amplum constituent, in quam cavitationem, si vulnus penetret, sine periculo esse potest, Interstitium hoc ad Sternon amplum est, Membranis tamen per Fibras quasdam sibi invicem annexis, cum vero ad Vertebrae appropinquat magis angustatur, & Membranae committuntur.*

In Cavitationem hanc Vapores flatuſq; Craſſiores contexti, cruciatus ac dolores acutiffimos excitant ad Sternon, Membranas ſcilicet iſtas divellentes, Fibraſq; quibus invicem Conneſcuntur violantes.

But with deference to this learned Author, I humbly conceive that this Cavity of the *Thorax*, in which he affirmeth many Diſeaſes are generated, is made by the preſſure of the Hand, when the Membranes are parted from each other in the taking of the Sternon; ſo that if a Diſſection be made by taking off the Ribs near the Vertebres of the Back, then you may diſcern the Duplicated *Pleura* to be affixed by Fibres to the Sternon, without any intermedial Cavity, only a hollowneſs may be ſeen about the Heart when a Duplication of the Membranes (relating to the Mediaſtine) embraceth the Heart with its *Pericardium*; and another long but narrow Cavity may be diſcovered about the Vertebres, Gullet, and *Aorta*.

The Veſſels of the Mediaſtine.

The Mediaſtine is accommodated with divers kinds of Veſſels, Veins, Arteries, Nerves and Lymphæducts, as ſome imagine.

It hath Veins from the *Vena ſine pari*, Arteries from the *Mammary Branch*, Nerves, from the *par vagum*, and the Phrenick and Stomacick Nerves, which paſſing between the Duplication of the Mediaſtine do in their progreſs impart ſome Branches to it.

The Mediaſtine hath Lymphæducts according to *Bartholine*.

Bartholine ſaith it is endowed with Lymphæducts, *Ait ille, Vaſa Lymphatica obtinet, quæ multis rivulis hinc inde per Mediaſtinum exorta, uno tandem tramite ingrediuntur laſteas Thoracicas, ſicut patet in figuris Rudbeckii, quorum uſus ex eodem, ut aquam inter Sternum & Mediaſtinum, ejuſq; Duplicationem Condensatam emungant, atq; ad Laſteum Thoracicum Duſtum amendant.* How rational this uſe may be, I leave to the more mature Judgment of the Learned Reader.

The firſt uſe of the Mediaſtine.

The Mediaſtine, as I apprehend, may have many uſes, of which the firſt may be, that by parting the Lobes of the Lungs one from another, it may preſerve thoſe lodged in one ſide from ſuffering, when thoſe of the other are afflicted with Inflammations, Abſceſſes, Ulcers, Wounds, &c.

The ſecond uſe.

The ſecond may be, as it is tied to the *Pericardium*, to keep the Heart in a due poſition, leſt it ſhould incline too much to either ſide, and ſo hinder its regular motion.

The third uſe.

The third is to aſſiſt the reſtitution of the Diaphragm, and keep it from too much preſſing down the Stomach, Viſcera and Inteſtines, after its motion is performed in Inſpiration.

CHAP. VIII.

Of the Thymus.

IN my Discourse of the *Thymus*, I will endeavour to give a short Account of its Situation, Origen, and Termination, and of its Coats, Surfaces, Figure, Substance, and Uses.

As to the first, it is seated adjoyning to the Mediastine, in the highest region of the middle apartment between the Arteries and Subclavian Veins, and most commonly under the Clavicle, climbing up to the lower part of the Neck; but in Calves, Lambs, and many other young Animals, it taketh its rise above the left Auricle of the Heart, and is fastned to the *Pericardium*, where its lower region is extended from the Heart to the highest Rib, and then is contracted into a slender Neck, which creepeth out of the *Thorax*, between the Spine and greater Thoracick Vessels, and then is enlarged again, and after a little space above the uppermost Rib, is divided into two branches climbing up the sides of the *Aspera Arteria*, and passing by the *Glandule Thyroideæ*, is terminated near the Maxillary Glands.

The situation
of the *Thymus*.

The rise of
the *Thymus* in
Calves, &c.

The *Thymus* is covered with a double Membrane, the outward is more thick, and the inward of a more fine consistence, so closely covering the Interstices of the Glands, that at the first sight the *Thymus* seemeth to be one Gland, but upon a stricter search in Dissection, it may be discovered a system of many Glands, whereof every one is invested with a proper Coat, and peculiar Vessels.

The outward
Membrane of
the *Thymus*.

This rare Compage made up of innumerable minute Glands, is divided in the Middle, and consisteth of an upper and lower Apartment, each of which is garnished with two rows of small Glands, and every one is enwrapped in a proper Tunicle (parting them one from another) and are all at last encircled with two common Integuments, conserving them in due order and situation, from starting out of their proper spheres.

The Com-
page of the
Thymus is a
System of ma-
ny minute
Glands.

These numerous Glands are adorned with various Surfaces, some are plain, other Convex, and a third Concave, by which they are so finely lodged one within another, and so closely conjoynd by the interposition of Vessels and Membranes, that they seem to make up but one entire Gland, but indeed are many, and may be separated from each other, without the violation of their proper substance and Coats, as I have often experienced in Dissection.

These fruitful Glands are beautified with variety of Figures, some are oblong, flat, roundish, pyramidal, and others orbicular, triangular, quadrangular, rarely equal in their sides.

The variety
of Figures be-
longing to the
Glands of the
Thymus.

The substance of these Glands, constituting the *Thymus*, is soft and white, as having great affinity with the *Pancreas*, and is endued with a more delicate taste, and consisteth principally of Membranes, and somewhat of a *Parenchyma*.

The Membranes are integrated of numerous Fibrils, so closely united, that they seem to be one entire substance, but being streined by a violent extension, the small Membranes holding the Fibrils together, are broken, and so they start and part from each other, and then the Fibrils are plainly discovered.

The Fibrils of
the *Thymus*.

Q q q q q q q q

And

The Fibrils
are made of
many Fila-
ments.

The Vessels of
the Thymus.

The Paren-
chyma of the
Thymus.

The first use
of the Thymus.

The second
use of the
Thymus.

A third use of
the Thymus.

And as the Membranes are composed of many Fibrils, so again every little Fibre is made up of many Filaments, finely tied together by the mediation of little Tunicles.

These Glands are furnished with variety of Vessels, Arteries, Veins, Nerves, Lymphæducts, which are divaricated through their substance.

The Arteries take their origen from the ascendent Trunk of the *Aorta*, and the Veins from the Jugular Branches, Nerves from the *par vagum* and Subclavian Plex; and the Lymphæducts having an obscure origen, do terminate into the Subclavian Veins.

Between these numerous Vessels is a soft, tender, white substance, which may be called the *Parenchyma* of these Glands, and is produced by a Liquor destilling out of the Nerves, and the Albuminous part of the Blood, the reliques of the Nutricious Particles, which by reason of their grossness cannot be received into the Pores of the Vessels; or if this Hypothesis doth not please you, I humbly conceive the *Parenchyma* may proceed from the Seminal Matter adhering to the sides of the Fibrils in their first Rudiment, filling up the Interstices of the Vessels and Nervous Fibrils.

And if any Person should deny these Assertions, as affirming the substance of the Glands to consist of Vessels, curiously interwoven in variety of Postures, to which it may be replied, That some part of the Albuminous matter of the Blood in its Circulation (or Seminal Liquor in the first Formation of the Fibrils) may accresce to their Coats, which groweth again Colliquated by immoderate preternatural heat in Fevers, and other diseases, and being again rendred fluid, as embodied with Vital Liquor, are received into the neighbouring Veins, whereupon the Glands become flabby, being lessened in their plumpness and dimensions, as being in part despoiled of the soft substance or *parenchyma* interlining the Vessels.

The use of the *Thymus* commonly assigned to it, is to support the divariations of the *Aorta*, and *Vena Cava*, whereof some branches are lodged in the body of the Glands, and others transmitted into the arms and muscles relating to the *Scapula*.

Another use some Anatomists do conceive is to defend the Subclavian Vessels from Compression, which else might be produced (as they imagine) by the motion of the Clavicles in Respiration.

But these uses (if any) are of less moment; and I believe the *Thymus* being a system of many Glands, consisting of variety of Vessels, is ordained by Nature for nobler ends; One may probably be to transmit a thin Spirituous Liquor by the Nervous Fibres, into the body of the Glands, to attenuate and exalt the Milky Liquor, of which some part is carried by branches of the Thoracick Ducts inserted into the substance of the *Thymus*: *Deusfingius* reporteth he saw a quantity of Milk flow out of the *Thymus* of a Dissected Puppy: And other Authors of great Name and Worth, Learned *Harvey* (*Sneider*) and *Hostius*, relate upon Autopsy, That they have discovered the *Thymus* of Infants to be turgent with Milk. *Bartholine* giveth this reason of it, *Sine dubio (ait ille) ex Lacteo Thoracico illuc divertit Chylus, ne copia oneretur Vena subclavia*. And I humbly conceive the Milk bedewing the substance of these Glands, to be impregnated with the Volatil Saline Particles of a select Liquor destilling out of the Nerves; whereupon the Chyle being enobled with Spirituous parts, is afterward conveyed into the Subclavian Veins, and *Cava*, from whence it is entertained with the Blood into the right Chamber of the Heart.

Another

Another use may be more clearly evinced from the Mechanism or structure of the part, for the *Thymus* being chiefly, if not wholly a Contexture consisting of variety of different Vessels, doth receive and transmit several Liquors, some importing Vital and others Nervous Liquor, as the Arteries and Nerves, and other Vessels, as the Veins do export the Blood, exalted with Nervous Juice, and the Lymphæducts a Serous *Lympha* Secerned from it; So that it may seem very probable the great number of Nerves derived from the *par vagum* and Subclavian Plex, are branched and inserted into the Glands of the *Thymus*, not to give motion or sense (with which these are not affected in any great degree) but to impart a choice Liquor, which is freely dispensed through the terminations of these Nerves into the substance of the *Thymus*; where it being separated from some Recrements, meeteth and associates with the Blood, which is afterward discharged into the Capillary Veins, whose Extremities do hold a due proportion in shape and size with the said Defæcated Liquors. Dr. *Wharton* giveth another account, Telling us in his Chapter *de Thymo*, That the Lymphæducts receive the more gross parts of the Nervous Liquor, and the purer are resumed into the Nerves, for the use of the Nervous parts in reference to the whole Body; whereupon to do the Author Justice, I will give you his own words, which relate to the Nervous Liquor, *Ubi superflua ejus partes in transitu per Glandula substantiam secernuntur & per Lymphæductus, purusq; liquor per Nervos in eandem disseminatos resumitur in partium Nervosarum totius Corporis usum*; But it will be difficult to apprehend this Learned Author's more curious Sentiments, how the Liquors strained through the smaller Pores of the body of the Glands, as through a fine Colatory, should be readmitted in the Extremities of the Nerves, and stem the tide of the Nervous Liquor, whose current runneth down from the Brain between the Filaments of the Nerves, clean contrary to this Retrograde motion, which tendeth upward and thwarteth the constant Deflux of the Animal Liquor from the Brain, whose gentle motion squeeseth it forward by the weight of the Liquor, as one drop presseth another forward.

The fourth
use of the
Thymus.

Lastly, I humbly conceive the most noble use of the Animal Liquor dropping out of the terminations of the Nerves, into the substance of the *Thymus*, is to contribute its Mite to the gentle fermentation of the Blood: The Animal Liquor being impregnated with Spirituous and Volatil Saline Particles in the Cortical Glands, and other Processes of the Brain, is at length transmitted into the *par vagum*, and thence communicated to the Subclavian Plex, into the substance of the *Thymus*, where it is embodied with the Blood, and conveyed with it into the Capillary Veins, and thence into the Subclavian Branches and *Vena Cava*, into the right Ventricle of the Heart, by whose repeated contractions the *Succus Nutricius* being dashed against the inward walls of the Chambers of the Heart, is broken into most minute Particles, whereupon the fine Saline parts of the Nervous Liquor being embodied with the Acide Atoms of the Blood, do produce a great part of its Intestine motion, consisting in a gentle effervescence and expansive motion (much assisted by the Elastick parts of Air) in which the more Volatil Atoms of the Nervous Liquor do endeavour to quit the more crude and more fixed parts of the Blood and Chymous Liquor, which confine the more Spirituous till the grosser parts grow refined and exalted, whereupon the Homogeneous parts, being of a Fraternity, do embody and assimilate themselves, for their mutual preservation, and the disagreeing Particles that cannot be reconciled by Intestine motion, to the Nervous Liquor blended with Blood,

The most noble use of the Nervous Liquor in the Glands of the *Thymus*.

Blood, are Secerned by several Colatories of the Body, where the Compage of Liquors being opened, their Recrements are discharged by numerous Excretory Ducts, where the Salival Liquor is thrown off by the Oval and Maxillary Glands, as well as Tonfils, and the more Serous Saline Recrements of the Blood and Nervous Liquor by the Glands of the Kidneys, and the more gross Sulphureous, by those of the Liver.

CHAP. IX.

Of a Pleurisy.

A Pleurisie.

A Pleurisy and *Peripneumonia* hath great affinity with each other, as being frequent companions; Sometimes the Pleurisie precedes the *Peripneumonia*, and other times the latter is antecedent to the first, and both have the same Cause, a gross Blood apt to stagnate and beget Inflammations both in the *Pleura* and Lungs.

A Pleurisie is sometimes Solitary, and sometimes accompanied with a *Peripneumonia*.

The Pleurisie is solitary sometimes, as being destitute of the company of a *Peripneumonia*. These Diseases may be distinguished from each other by proper Symptoms; an Inflammation of the Lungs is accompanied with a higher Fever, and greater difficulty of breathing, than a Pleurisie, which is attended with a pricking pain in the Side, which sometime inclineth toward the Neck, and other times toward the Hypochondres, as the different parts of the *Pleura* are affected.

A Bastard Pleurisie.

In a Bastard Pleurisie, which is an Inflammation of the Intercoastal Muscles, there is little or no Fever, or Cough, no spitting of Blood, the Pulse less high, the pain of the Side is less pricking, and more beating, and doth not affect the parts adjoining to the Neck and Hypochondres.

The symptoms of a Pleurisie.

The symptoms attending a true Pleurisie or Inflammation of the *Pleura*, are first a violent pricking pain of the Side, a continued acute Fever, though not so high as in a *Peripneumonia*.

Secondly, a Pleurisie is accompanied with a quick and low Respiration, by reason the Flethy Fibres of the Intercoastal Muscles cannot so highly contract themselves because the *Pleura* is enflamed; So that the disordered Oeconomy of Nature endeavoureth to compensate the defect in magnitude, with the frequent repeated acts of Respiration, in order to the reception of Air to give an allay to the immoderate Effervescence of Blood, and to attenuate its grossness by its fluid Elastick Particles, in reference to motion, the great preservative of Life.

The description of a Pleurisie.

A Pleurisie may be thus described, *vid.* an Inflammation of the *Pleura* (caused by gross Blood stagnated in the Interstices of the Vessels) accompanied with violent pricking pain of the Side, an acute Fever, and a great difficulty of breathing.

The continent cause of a Pleurisie.

The immediate or continent cause of this Disease, is a thick mass of Blood associated with indigested Chyme, not well assimilated into Blood, whence it is rendred gross and clammy, and being carried by the intercoastal Arteries, into the substance of the *Pleura*, it Stagnates, and inflames the part, as gaining an Effervescence by Extravasation.

The

The more remote causes of a Pleurisie, are gross humors, as indigested Chyme, caused first by Aliment hard to be Concocted; as also by prohibited Transpiration, flowing from cold Ambient Air, shutting up the Pores of the Skin, and detaining the gross steams in the Blood, which else would have been thrown off by Transpiration; these having recourse with the Blood into the empty spaces of the Vessels, do produce a Pleurisie, to which a watry Air clogged with thick Vapours, free Cups of Wine, and immoderate eating do dispose the Blood, as rendring it gross and depauperated, and fitted for Stagnation in the substance of the *Pleura*.

The remote
causes of a
Pleurisie.

As to the Prognosticks of this Disease, the danger appeareth very much in the height of the Fever, and the difficulty of Breathing: And *Hypocrates* giveth his opinion in it by Spittle, when it hath none, or else unconcocted, or discoloured, and conceiveth a Pleurisie to be sooner determined, if the Spittle be excerned in the beginning of the Disease.

The Prognos-
ticks of a
Pleurisie.

Ἀπὸς καὶ πύον ἐπιφαμένον, οἷον ἐν πλευριτικῇ πτύελον ἢν αὐτὴν ἐπιφαίνεται, Ἀρχαίως βεβαίως. ἢν δὲ ὕδα-
ρον ἐπιφαίνεται, μὲνεται. *Quinetiam & per ea quæ mox apparent eadem indicantur*
quale quid in morbo laterali laborantibus, Sputum si statim circa initia subappareat,
morbum brevem, si vero posterius videatur, longum futurum denunciat.

And the Pleurisie is most dangerous when there is no excretion of Spittle, and less dangerous, when some thin Serous Liquor is ejected, and more safe when the Spittle groweth thicker and concocted, which if it happen about the third or fourth day, the Disease will determine about the seventh.

Yellow Spittle being accompanied with much watry Recrements, is not safe, especially green or black Spittle, seemeth to be fatal, as shewing the humor to be of a depraved nature, flowing from the great decay of the Vital heat.

A Flux of Blood by the Nostrils, Hamorrhoides, or *Menstrua*, doth often presage a good termination of this Disease, if the signs of Coction do appear in the Spittle, as being thick and not too clammy, and expectorated with ease, attended with a freedom of breathing.

But if the Patient hath his body unequally affected, in some parts hot, in others cold, outwardly afflicted with chilness, and inwardly with a burning heat, associated with great pain, anxiety, and a high *Delirium*, they speak the approaches of Death.

This Disease presenteth us with three Indications in reference to its Cure, the first relateth to the Disease it self, which is an Inflammation of the substance of the *Pleura*, flowing from a quantity of Blood, lodged in the Interstices of its Vessels; whereupon a Vein is to be opened in the Arm, and a free mission of Blood to be celebrated, to empty the Vessels, and to make good the circulation of the extravasated Blood in the *Pleura*, which lessens the Inflammation, and cannot be so well effected by often taking away a small proportion, as by letting out a great quantity of Blood at once, which hasteneth the motion of the Blood, and not permitteth it to grow over lentous, and Concreted by its long stay in the spaces of the Vessels, which rendereth its motion very difficult, or not at all feasible; whereupon the Blood putrieth if long Extravasated, producing first an Abscess, and afterward an Ulcer, attended with an *Empyema*: Whereupon it is requisite at the first time, (if the Pulse be great in a Plethorick body) to take away a large proportion of Blood, as most prevalent to obtain a conquest of the Disease.

The Indica-
tions of this
Disease.

Rrrrrrrrr

So

Bleeding is
very proper
in a Pleurisie.

So that Bleeding hath been advised in a Pleurisie with the general suffrages of the *Grecian, Arabian, Italian, and French* Physicians, in the Hand or Arm of the opposite side, to make the greater revulsion; But Great Doctor *Harvey* and the Modern Physicians, as better versed in Anatomy have discovered the circulation of Blood, and have since found by experience, that opening a Vein in the same side where the Pleurisie is seated, to be far more beneficial to take off pain, and the Inflammation, by promoting the current of stagnated Blood in the part affected, by soliciting the motion of the Blood out of the ascendent Trunk of the *Aorta* into the Subclavian, Axillary, and *Brachial* Arterial branches, and by consequence freeth the affected side of the *Pleura* from a load of Blood.

And if the mission of Blood cannot be celebrated by reason of a languid Pulse, though the pain of the Side and Fever be high in the Pleurisie, it denoteth Cupping Glasses with Scarifying, to be applied to the affected Side, which hath often spoke great ease by drawing off Blood from the afflicted and inflamed part, and by renewing the interrupted course of Blood.

Strong Purgatives are
not proper in
a Pleurisie.

This Disease doth no way admit strong Purgatives and Vomits (often advised by Empyricks) which highly exagitate the offensive Recrements of the Blood, and render the Inflammation greater, and weaken the Patient, and strengthen the Disease, by hurrying the Blood more impetuously into the parts affected, and by lessening the strength of the sick Person, whereby the Coction of the Morbifick Matter is hindred, and Death hastened, by the Ignorance and Impudence of unlearned Practisers in Physick, who boast much, and do little or nothing, who aim to make themselves great by lessening others, which rendereth them guilty of Injustice, Arrogance, and Uncharitableness.

Gentle Purgatives may be advised, if the Fever be not high, as also Juleps and Apozemes (that allay the heat of the Blood) mixed with gentle Diureticks and Sudorificks.

The second
Indication in
the Cure of a
Pleurisie.

The second Indication relateth to the cause of the Pleurisie, which proceedeth from a gross mass of Blood apt to stagnate, and doth denote attenuating Medicines made of Apozemes prepared with Dogs Grass, Wild *Asparagus*, and mild Pectorals, in case of a Cough and in a *Peripneumonia*, which is often a companion of this Disease; Testaceous Powders, full of Volatil Salt, as Crabs Claws, Pearl, the Mandible of a Pike, the Bone of the Heart of a Stag, as also *Sal Prunella*, Salt of Coral, Urine, and Volatil Salt of Harts Horn, the Infusion of Horse Dung made in red Poppy Water, and White Wine are very useful.

Thickning
Medicines are
good in a thin
Effillation.

In reference to the sensible evacuation of the Matter of the disease by Spittle, the Medicines admit great variation: In case of thin Recrements (which Nature endeavoureth to throw off by Expectoration, but cannot well attain to it, by reason the humors being of a thin consistence, do elude the impulse of the thinner Air) thickning Medicines are to be advised, made of Jujubes, Sebesten, Gum of *Tragananth*, Arabick, *Looch de Psyllio*, *de Portulaca*; and a Pectoral Decoction made with the Flowers of Red Poppy, Seeds of Melons, Pumpions, White Poppy, Barley, Jujubes, Dates, &c.

Attenuating,
inciding, and
detergent
Medicines, are
prop r in a
gross, viscid,
lentous Mat-
ter.

In a thick Matter, which is gross, lentous, and viscid, attenuating, inciding, and detergent Medicines may be prescribed, as all kinds of Oxy-mels, (especially that of Squills) are very proper, and a *Linctus* made of Linseed Oyl, or Oyl of sweet Almonds, mixed with White Sugar Candy; Apozemes made with Dogs Grass, Wild *Asparagus*, Hysope (if the Fever be not high) Maiden Hair, Coltsfoot, Scabious, Liquorice, Shavings of Ivory, &c.

In

In a gross Matter, which cannot be Expecterated without great difficulty, an Infusion of Horse dung made with the Leaves of *Maries* and the blessed Thistle, made in Water and Wine, and being strained, may be frequently given with good success.

Topicks are very beneficial in this Disease, made of Oyntment of Marsh Mallows, Oyls of Chamemel, Horse dung, &c. as also Cataplasms prepared with White Lilly Roots, Leaves of Mallows, Marsh Mallows, St. John's Wort, Seeds of Fenugreek and Flax, boiled in Water to a due consistence.

Topicks are good in this Disease.

Ætius, an Antient Physician, adviseth in this case Cupping-Glasses to be applied with Scarification, as a most present Remedy to evacuate the Matter of the Disease, and to take off pain.

The third Indication in a Pleurisie, is preservative of strength, which may be satisfied with a thin Diet of Water and Barley Gruel, Panada, thin Chicken broth, Barley Cream, &c. as also ordinary Drink, Ptisanes, Small-Beer boiled with a Crust of Bread and a Blade of Mace, and being strained, may be sweetned with double Refined Sugar; Posset-drinks are also proper made most with small-Beer, and a very little White Wine and dulcified with Sugar, and Emulsions made with the cooling Seeds, sweet Almonds blanch'd, and sweetned with Sugar-Candy; Cordial Julapes made with cooling and temperate Medicines, are profitable, made with distilled Water of *Maries*, and the blessed Thistle, Balm, Black Cherries, Citrons, to which a small Plague-water may be added, and prepared Pearl, or Coral, with a little Sugar-Candy.

The third Indication in relation to the Cure of a Pleurisie.

Powders of Crabs Eyes, Coral, Pearl, Flowers of Red Poppy, being that of the Field, &c. given with a draught of a proper Cordial Julep, which do produce gentle Sweats, and allay the heat of the Blood, which is sometimes very high in a Pleurisie.

And to conclude, Horse dung, Leaves of *Maries*, and the blessed Thistle, Scabious, Hysope, Pimpernel, Flowers of Field Poppy distilled in a little White Wine, and a far greater proportion of Milk, do speak a great advantage in this Disaffection.

Cooling and Diaphoretick Julapes are very advantageous in this Disease.

C H A P. X.

Of an Empyema, or Collection of Matter in the Cavity of the Breast.

AN *Empyema* is an unhappy Companion, or rather a sad consequent of other Diseases, which being not well determined, do fall into this disaffection, flowing either from an inflammation of the *Pleura*, Mediastine, Lungs, *Larynx*, or a quantity of Blood flowing out of a broken Vessel of the neighbouring parts into the Cavity of the *Thorax*; whereupon I humbly conceive that an *Empyema* is not a primary Disease seated in the *Pleura*, Lungs, *Larynx*, but a quantity of dislodged Matter, as discharged the Confines of the adjacent parts into the empty space of the Breast.

An *Empyema*,
flowing from
an Inflamma-
tion of the
Pleura.

An *Empyema*, following an inflammation of the *Pleura*, proceedeth from a source of Blood stagnated in the Interstices of the Vessels, which being long Extravasated, doth degenerate into a *Pus*, making an Abscess, which being not discharged, doth Corrode the tender Membranes of the *Pleura*, and run into the Cavity of the Breast.

An *Empyema*
derived from
an Inflamma-
tion of the
Lungs.

This Disease is derived also from a *Peripneumonia*, wherein a large proportion of Blood being settled in the substance of the *Sinus* and *Bronchia* of the Lungs, and not discharged out the Terminations of the Pulmonary and Bronchial Arteries, into the Origins of the Veins, accompanying the said Arteries; whereupon the Blood for want of motion is despoiled of its due Tone and Disposition, and acquireth a putrid Disaffection, giving it a kind of Caustick quality, Corroding the Coats of the *Bronchia* and appendant Membranous Cells of the Lungs; So that if the Purulent Matter being lodged in a small quantity in the empty spaces of the Air-vessels may be discharged by Expectoration, the Patient may recover without any further prejudice; but if the Putrid Matter be so Exuberant that it cannot be expelled by a Cough, but farther Corrodes the substance, and at last the outward Coat encompassing the Lungs, it breaketh the Confines of its Banks, and overflows into the Cavity of the *Thorax*.

An *Empyema*,
following a
Squinancy.

A third kind of *Empyema*, may take its rise from a true Squinancy, wherein so great a proportion of Blood is lodged in the Interstices of the Vessels relating to the Muscles, besetting the head of the Wind-pipe, that the circulation of the Blood cannot be made good out of the Extremities of the Arteries into the beginnings of the Veins; whereupon the settled Blood losing its innate bounty by a long Stagnancy, doth degenerate into a putrid Matter, which first maketh an Abscess and then an Ulcer in the Muscles of the *Larynx*, and then descends by the outward surface of the *Bronchia* to that of the Lungs, and afterward into the capacity of the *Thorax*, producing an *Empyema*.

An *Empyema*
coming from
the broken
Vessels of the
Lungs.

The fourth kind of *Empyema* is assigned to Extravasated Blood, coming out of broken Blood-vessels of the Lungs, discharging a quantity of Purple Liquor into the Cavity of the Breast, where it is rendered destitute of its Spirituous and good Particles, as wanting motion, but by reason the Blood is not turned into *Pus*, (as I imagine) it cannot be called an exquisite *Empyema*, which

which speaketh not every kind of a degenerate Extravasated Blood, but such a one as is turned into a true Sanious or Purulent Matter, which is produced from Blood first stagnated in the substance of Membranes, Muscles, or the *Parenchyma* of the *Viscera*, as of the Lungs, Heart, Liver, Spleen, Kidneys, &c. wherein the Serous Particles of the Blood are turned into *Pus*, produced by the heat of the said parts, which cannot be effected by Extravasated Blood flowing out of a broken Vessel, and lodged in a Cavity relating to any of the Venters.

The Continent cause of an *Empyema*, is a *Pus* or purulent Matter, flowing out of the Muscles of the *Larynx*, body of the Lungs, *Pleura*, *Mediaſtine*: A Learned Physician was of an opinion, that *Pus* and Purulent Matter, might admit a distinction, as the first proceedeth from the corrupted *Succus Nutritivus* of the Blood, and the second from its Serous Recrement, as coming from the hindered motion of the Blood, rendring it putrid.

The continent
cause of an
Empyema.

And another worthy Author conceiveth, That true *Pus*, being white and of a middle consistence, is confined within a proper Membrane or *Cystis*, and being brought to a perfect Maturation, and broken, soon dischargeth it self, and the part affected is Cured; but Purulent Matter unconfined and left at large, as destitute of any *Cystis* or Membrane, when it is discharged by an Ulcer, appeareth Sanious, unconcocted, as the putrid Excrements are mixed with Purple Liquor, which maketh the Diseased part more difficult to be Cured, by reason it is clogged with a great source of Crude, Sanious Excrements not easie to be discharged.

It may be also considered, that both the pure *Pus* and the Purulent Matter, are sometimes affected with an ill savour, and other times are destitute of an ill scent; So that Apostemes brought to Maturation, and broken, do emit a stink, and sometimes none; whereupon I humbly conceive that Purulent Matter flowing out of an Ulcer, doth often discompose our Nostrils with a fatide smell; and it may be observed that an Apertion being made between the Ribs, to discharge an *Empyema*, the Purulent Matter hath little or no smell, and after two or three days, when the Air hath had a frequent recourse by the Wound into the *Thorax*, the Purulent Matter groweth very offensive, which may be quickly alayed by some injections of Wine, as washing and cleansing the sides of the wound and adjacent parts, and diluting the stinking corrupt humors with pleasant Aromatick smells: And I humbly conceive that the fatide smell of *Pus* and Purulent Matter, doth arise out of gross exalted sulphureous depressing the Saline Particles; but on the other side, when the sulphureous parts are somewhat Concocted, and reduced under the power of the Saline, they give a check to the ill savour of *Pus* and Purulent Matter.

As to the Diagnosticks of an *Empyema*, some of them, and the most chief may be these; When the Inflammation of the Muscles of the *Larynx*, Lungs, *Pleura*, or *Mediaſtine*, do not cease upon the due application of Remedies, and are attended with Rigors and Fevers, it is very suspicious, the Inflammation is determined by an Ulcerous Matter discharged into the Cavity of the Breast.

The Diagnosticks of an
Empyema.

If the Extravasated Blood settled in the substance of the Muscles of the *Larynx*, Lungs, *Pleura*, or *Mediaſtine*, be not taken off by due Application in fourteen days or thereabouts, it doth degenerate into *Pus*, productive of an Abscess in the part affected, which sometimes breaketh about the twentieth day, and other times about the thirtieth or fortieth; Of which *Hippocrates* giveth these Symptoms, A Rigor, saith he, proceeding from a Puru-

Extravasated
Blood is turned
into Blood
in fourteen
days.

S s s s s s s s

lent

lent Matter, Vellicates the neighbouring Membranous parts, accompanied with a dull pain, arising from the weight of the corrupt Matter (afflicting the Lungs in their Diastole) depressing the Diaphragm, and hindring its relaxation, in order to a farther motion made by Contraction; hence ensueth a difficulty of Respiration, flowing from a quantity of Purulent Matter stuffing the Cavity of the Breast, giving a check to the free play of the Lungs and Diaphragm.

The sign of a long Empyema.

The sign of a long continued *Empyema*, is, That the Fever groweth more mild upon the great part of the *Pus* transmitted out of the body of the parts affected, into the empty space of the *Thorax*; So that the Fever is rendred partly Putrid and partly Hectick, always infesting the Patient, and is more gentle in the Day, and receiveth the beginning of an Exacerbation about the Evening, and is more heightened about the middle of the Night. This Disease is associated with a perpetual Cough, sometimes throwing up Purulent Matter, whereupon ariseth a great Anxiety, and dejection of strength, proceeding from free Sweats in the Night; whence follow the hollowness of the Eyes, and redness of Cheeks, and at last a swelling of the Legs, producing a *Leucophlegmatia* flowing from a gross and dispirited mass of Blood, stagnating in the substance of the parts affected.

The Prognosticks of an Empyema.

The Prognosticks of this Disease are hopeful, if when the Abscess is broken, the Fever groweth gentle, attended with an easie Expectoration of Purulent Matter, or rather of a *Pus* that is smooth, white, and equal, and with a free Respiration, which sheweth the *Thorax* not to be overcharged with a quantity of *Pus*.

Pus accompanied with a violent Fever, is dangerous.

But on the other side the Prognosticks imply imminent danger, when the Eruption of the *Pus* is accompanied with a violent Fever, frequent Tremblings, or Rigors; which are Convulsive Motions, proceeding from ill-conditioned Purulent Matter, highly irritating the Nervous parts.

A Cough with a difficulty of Breathing, is very dangerous.

A great Cough (accompanied with a difficulty of breathing) is very dangerous, by which a thick, yellow, green, black, or fetide, corrupt Matter, of an unequal consistence is thrown up, especially in an *Orthopnea*, wherein the whole Breast is lifted up; whereupon most commonly ensueth a Suffocation, proceeding from an Exuberance of Purulent Matter, lodged in the Cavity of the Breast, and intercepting the motion of the Intercostal Muscles, Diaphragm and Lungs.

It also foretelleth great danger, if a silver Probe be put into the wound of an opened *Thorax* for an *Empyema*, and groweth hued with the colour of Gold or Copper, which is caused by the exalted Sulphureous Particles of the Purulent Matter, discolouring the Silver. But it is more safe, if the Patient grow strong, as having a good Pulse, and free Respiration, upon the Aperition of the *Thorax*; whereupon floweth a white well Concocted Matter, speaking an Alleviation of the Fever and all the symptoms of the Disease.

In case an Ulcer of the *Larynx*, Lungs, or *Pleura*, cannot be prevented by Bleeding, Expectoration, Diureticks, and Diaphoreticks, gentle Medicines may be advised both inwardly and outwardly, that promote Suppuration.

Hydromels are proper in a Cough proceeding from a gross, lentous, viscid Matter.

In reference to a Cough derived from gross, lentous, viscid Matter, Hydromels are very proper, made up of the five opening Roots, the Leaves of Ground-Ivy, Coltsfoot, Horehound, Scabious, Maiden-Hair, and Raisins of the Sun stoned, boiled in Water, to which White-Wine may be added at the latter end of the Decoction, and when it is strained, some Honey may be gently boiled in it.

Medicines

Medicines made into Pills with *Chio Turpentine*, *Iris Root* powdered, and Syrup of *Ground-Ivy*, which may be rowled in Powder of *Liquorice*, and given Morning and Evening with a *Vulnerary Decoction* made of the Roots of *Sarsa Parilla*, and *China*, *Hartshorn Shavings*, *Prunell*, *Bugles*, *Sanicle*, *Moufe-Ear the Great*, *Ground-Ivy*, boiled in three parts *Water*, and one part *White-Wine*, to which, being strained, *Honey* may be added. These Medicines do satisfie all the Indications of an Ulcer as they cleanse, dry, and Consolidate.

As to an *Empyema* flowing from an Ulcer of the Muscles of the *Larynx*, *Lungs*, *Pleura*, and Medicine, the *Pus* or Purulent Matter cannot be evacuated if it be lodged in a very great proportion in the empty space of the *Thorax*, unless a wound be made in the *Intercostal Muscles*, as near to the *Midriff* as may be (with great regard of its preservation) that the Purulent Matter may be the better expelled through the Aperture of the Breast, which is sometimes made between the fourth and fifth, and other times between the sixth and seventh Rib.

Sometimes the *Succus Nutricius* of the Blood (being lodged in a great quantity in the substance of the *Bronchia*, and Membranous Cells, their Appendants) is turned into a *Pus*, making first an *Aposteme*, and afterward an Ulcer, through which some Corrupt Matter is received into the *Bronchia*, and Expecterated, and some of the other part of the *Pus* was lodged in the Cavity of the *Thorax*, and other parts may be evacuated downward by Stool, and upward by Vomiting, as also by Urine, by reason Nature is very solicitous by all ways possible to preserve it self by various Evacuations of ill Matter.

Of this admirable case I shall take the boldness to give an Instance, in Mr. *Echins*, a Gentleman of *Northampton-shire*, (related to a Person of Honour, Colonel *Stroade*, Governor of *Dover-Castle*) who was oppressed with a great Cough, a high difficulty of Breathing, accompanied with a slow putrid Fever, and many other Diagnosticks, which follow an Ulcer of the Lungs and an *Empyema*, flowing from a source of Purulent Matter (entertained from the confines of the Lungs into the capacity of the Breast) falling down upon the *Diaphragm*.

In order to evacuate the Matter of this Disease, and to relieve the agrieved Lungs, and Midriff, an Apertion was made in the *Intercostal Muscles* between the Ribs, by Mr. *Pierce*, a Skilful Chyrurgeon, relating to the Hospital of *St. Thomas*; whereupon the *Thorax* being opened, a quantity of Sanious and Purulent Matter was discharged through the wound; and he also freely Excerned it by Coughing, Vomiting, by Stool, and by Urine; All these Evacuations were plain to sense, but the great difficulty remaineth, how Nature could expel the Peccant Matter by these several ways; which I humbly conceive, may be accomplished after this manner; Some part of the *Pus* was transmitted into the *Bronchia*, and thrown up by Coughing, and some other portion of it was entertained out of the substance of the *Bronchia* and *Sinus* (only *Apostemated* and not *Ulcered*) into the Extremities of of the Pulmonary Veins, and carried through the left Ventricle of the Heart (causing great faintness and dejection of Spirit, attended with a Fever) and Descendent Trunk of the *Aorta*, into the *Cæliack Artery*, and its Terminations into the Cavity of the Stomach, whence it was expelled by Vomiting, and afterward some part of the *Pus* was conveyed farther by the Descendent Trunk, into the Branches and Extremities of the upper and lower *Mesenterick Arteries*, into the Cavity of the Intestines, and thrown off by Stool; and the reliques of the Purulent Excrements not carried off by the *Cæliack* and *Mesen-*

An Apertion of the *Thorax* may be made in a desperate *Empyema*.

Sometimes the *Pus* is discharged by Cough, Vomiting, Stool, and by the wound made in the Apertion of the Breast.

An Instance of this case in Mr. *Echins*, a Gentleman of *Northampton-shire*.

Mesenterick Arteries, did descend lower by the said Arterial Trunk, into the Emulgent Arteries and their Capillaries, implanted into the Glands of the Kidneys, in which a Secretion was made of the Purulent Matter, (from the Blood) and embodied with the Serous Recrements, whereupon they were received into the Urinary Ducts, and carried through the *Pelvis* and Ureters, into the Cavity of the Bladder, and thence Excerned with the Urine through the *Urethra*.

The Cure of an Empyema by an Aperition of the Thorax, Pectorals, Diureticks, and Healing and Consolidating Medicines, and Restoratives in reference to the Heftick Fever.

In order to the Cure of these many Complicated Diseases, I advised Hydromels made of Pectorals, to help the Expectoration of Purulent Matter, and of Diureticks to carry it off by Urine; and in reference to the Ulcer, I prescribed cleansing, drying, and Consolidating Medicines; and in point of the Heftick Fever, I ordered attemperating and restorative Applications made of *Chyna*, *Sarsa Parilla*, Ground-Ivy, Maiden-Hair, Shavings of Ivory, and Harts-horn boiled in Water and Honey; as also destilled Milks made with Pectorals, Diureticks, Vulneraries, Restoratives, which were given with new Milk; as also in this case Balsomick Pills and Syrups may be administered with good success; and in point of Diet the Patient did eat and drink Milk all manner of ways, Milk boiled with Bread, and Water boiled sometimes with Barley, and other times with Oatmeal, to which Milk was added to make a Pottage, which is proper in this Disease, as being cleansing and restorative: By this method of Physick and Diet, the Patient was perfectly restored to his health and strength, many years ago, and is yet alive and healthy as a Monument of God's wonderful Mercy; And I hope will live long to speak his great Praise and Glory in the land of the Living.

CHAP.

C H A P. XI.

Of the Pericardium or Capsula of the Heart.

THe *Capsula* or Membrane, encompassing the Heart, is a strong firm Enclosure, made up of minute Fibrils, curiously Enterwoven, and is Contiguous to the Heart at some distance, to give it a free play in its various Alternate motions of Systole and Diastole, or rather Contraction and Relaxation.

The Com-
page of the
Pericardium.

It deriveth its Origen near the Base of the Heart from the external Coat of the *Pleura* or Mediastine, which encircleth the Vessels divaricated through the outward surface of the Heart.

The Origen
of the Peri-
cardium.

Most Anatomists do assign but one Membrane to the *Pericardium*, and Learned *Riolan* two, and I humbly conceive it to be furnished with three; The first and outward proceeding from the Mediastine, is fastned to the Middle Coat by the interposition of many thin Tunicles, which I discovered in parting it from the second Membrane.

The outward
Coat of the
Pericardium.

The outward is accommodated with many Cells or Membranous Vesicles, the repositories of Fat, which in a well stalled Ox doth very much shade and immure this first Integument.

The middle Coat being closely conjoyned to the outward, is somewhat thinner than it, and is composed of a great company of Fibres finely interwoven and close stuck, and interspersed with a white *Parenchyma*.

The middle
Coat.

The third Tunicle whose inside maketh the inward surface of the *Pericardium*, is the most fine of all the Coverings, which I severed from the middle Coat, and discovered it to be beset with many minute Glands, the Fontinels, as I apprehend, of the Serous Liquor contained in the *Pericardium*.

The third
Coat.

As to its Connexion, it is fastned in its outward surface to the Mediastine by the interposition of many Fibrils, and conjoyned to it about the Base of the Heart, where a passage is made to the Blood-vessels, and in its lower Region to the Center of the Diaphragm.

The Connexion
of the Peri-
cardium.

The Contexture of this Membrane hath much affinity with that of other Membranes, relating to the Body of Man, as it is a strong Compag made up of a great store of Membranous Filaments or Nervous Fibrils, curiously spun and interwoven, and interspersed with a *Succus Nutricius*, or Seminal Matter, adhering to the sides of the Coats of the Fibrils in their first Generation.

The Structure
of the Peri-
cardium.

This Membrane is furnished with small Vessels of different kinds, Veins from the Phrenick and Axillary branches, and Arteries, though very small, from the Coronary branches of the Heart, and small Nerves from the left recurrent Nerve; and also Lymphæducts, as Learned *Rudbeck* will have it, proceeding from the Trunk ending near the Heart.

The Vessels of
the Pericar-
dium.

The Figure of the *Capsula* holdeth great conformity with that of the Heart, and is much more enlarged toward its Base, and groweth more narrow near its Cone; So that the *Pericardium* is adorned with a kind of Pyramidal figure.

The Figure of
the Pericar-
dium.

The Liquor
contained in
the Pericar-
dium.

In this *Capsula* Serous Liquor is contained as in a Cystern, which some account to be Alimentary, and others Excrementitious, as being a Watry humor proceeding from the steams of the Blood arising like Clouds, and condensed against the inside of the *Pericardium*.

The Origin
of the Liquor
contained in
the Pericar-
dium.

Learned *Steno* deriveth its Origen from the Lymphæducts coming from the Conglomerated Glands, in his Books *de Musculis and Glandulis*, p. 41. *Quocunq; corporis Animalis loco aquosus quidam naturaliter reperitur humor ejus superficiem oblinens, eandem superficiem Lymphaticorum pertusam ostiis a Conglomerata Glandula oriundorum: unde colligere liceret, eandem aquæ Pericardii esse originem*, but with the leave of this great Author (I humbly conceive) that the Liquor lodged within the confines of the *Pericardium* doth not arise from the Lymphæducts, which is a thin watry Liquor, but this of the *Capsula Cordis* is the Serous part of the Vital Juice, as I apprehend, by reason it being exposed to the Fire, will Coagulate like the white of an Egg, which sheweth it to be the more soft and albuminous Particles of the Blood.

Renowned Dr. *Lower*, doth fetch the Liquor contained in the *Capsula Cordis* from its Glands, as he hath in the first Chap. *de Cordis situ & structura*, p. 5, 6. *Quare ut aquæ hujus fontem alibi quæramus, advertere oportet naturam in variis corporis partibus ubi operis aut functionum eadem aut par ratio est, iisdem plerunq; Machinis atq; instrumentis uti; & quemadmodum glandulas Lacrymalis ad humorem suggerendum quo Oculi illinantur, atq; madefiant (absq; quo sicci & motus inhabiles evaderent) pariter & juxta Cordis basin diversas Glandulas constituit, è quibus humor intra Capsulam exstillat, & vacuo isto spacio huc illuc agitatus Cordis superficiem undiq; alluit, quo promptior & facilior ejus motus redderetur.*

CHAP.

C H A P. XII.

Of the Diseases of the Pericardium, and their Cures.

THe *Pericardium* (as composed of many Coats, furnished with numerous divarications of Vessels) is rendered obnoxious to variety of Diseases, as Inflammations, Abscesses, Ulcers, Tumors, &c.

The inflammation of the *Capsula Cordis*, is derived from a source of Blood coming out of the Terminations of the Coronary Arteries of the Heart, inserted into the substance of the *Pericardium*, in which it is Extravasated, as not being received into the Extremities of Phrenick Veins by reason of its great plenty or grossness; whereupon it being stagnant in the empty spaces of the Vessels, loseth its laudable temper and bounty, by gaining an unkindly Ebullition; This part confining on the Heart easily affected with an unnatural effervescence (productive of an acute Fever, Syncope, Palpitation) imparted to the Blood first derived from the substance of the *Pericardium* into the Origens of the Phrenick Veins, and from thence to the *Vena Cava*, and right Ventricle of the Heart, and afterward into the Lungs, where it creates a great difficulty of Breathing, a dry Cough, a great *Plogosis*, &c. Thirst, and sometimes with a pain in the *Thorax* toward the Sternon, as the *Pericardium* is affixed to the Mediastine; So that this Disease is taken for a Pleurisie, *Zacutus Prax. adm. Lib. 2. Observat.* giveth a History. *Quidam in etate florente acuta febre est prebensus cum siti ingenti, anxietate, Respiratione celerrima & frequenti, Thoracis incendio, tussi sicca, Syncope, Cordis tremore, levissimo in Thorace dolore Sternum versus, cum angustia summa, pulsu duro & inequali. Hic pro Pleuritico Curatus, triduo è vita sublatus.*

The cause of an Inflammation of the *Pericardium*.

Sectio à morte palam fecit fuisse Pericardii Inflammationem, nam tota fere tunica livida & rugosa visa est, & in multis partibus asperitudines apparere Milliacea, nigrore infecta, omnia ab adurente calore profecta.

The Curatory Indication of this Disease being a quantity of extravasated Blood lodged in the substance of the *Pericardium*, doth denote the Mission of Blood with a free hand, to make good the Circulation of the stagnant Blood in the parts affected; That it may be received into the Phrenick Veins, and take off the Inflammation of the *Pericardium*.

The opening of a Vein is good in an Inflammation of the *Pericardium*.

Bleeding also satisfieth the preservatory Indication in lessening the cause of the Disease, by taking away the exuberant quantity of hot Blood, and by diverting its current from the *Pericardium* by opening a Vein in the Arm. Cooling Juleps and Apozemes are very proper in being given with temperate Cordial Powders, which do cool the Mass of Blood, by Sweat and a free Transpiration, as discharging the hot steams of the Vital Liquor by the Pores of the Skin.

Sometimes an Inflammation may proceed from a great Contusion of the *Thorax* affecting the *Capsula Cordis*, whence ariseth first an Inflammation, coming from a Laceration of the small Arteries pouring out so great a quantity of Blood into the Interstices of the Vessels, that the minute Origens of the Veins are not capable to give a reception to it; So that the Extravasated Blood losing its motion, the Albuminous part degenerates into a *Pus*, which often

Another cause of an Inflammation of the *Pericardium*.

often Corrodeth the Membranes of the *Pericardium*, and produceth an Ulcer, which vitiateth the Liquor encircling the Heart.

An Instance of
an Inflammation
of the
Pericardium
proceeding
from Contu-
sion.

A Husband-man overturning a load of Hay by his imprudent Conduct, some part of it fell upon his Breast, which thereupon was highly afflicted with pain, and the Patient was afterward infested with an acute Fever, flowing from the Contusion of the *Pericardium*, which proved fatal unto him, and the *Thorax* being opened and his Heart inspected, the *Pericardium* was found full of Pus, in which the Heart did swim as in a noysom Lake, giving it a stench and suffocation.

A Dropsie com-
ing from
too great a
quantity of
Liquor con-
tained in the
Pericardium.

The *Pericardium* is sometimes swelled, as overcharged with too great a quantity of Serous Liquor, making a kind of Dropsie, whereby the *Capsula* being of tender Membranous Compage, is highly discomposed with pain, and the Heart compressed with a load of Liquor so incumbent upon it, that its branches cannot admit a due Dilatation to give reception to the Blood, which is attended with a pain of the Breast, a trembling of the Heart, and a Dropsie of the whole Body.

A young Man being tortured with a pain of his Side, and a great Palpitation of his Heart, proceeding from a superabundant quantity of Water lodged in the bosom of the *Capsula*, which generated a Heftick Fever, destructive of the Patient, who being opened in his middle Apartment, the *Pericardium* was found highly distended, as being Hydropical and full of Serous Liquor drenching the Heart, and rendring it very soft and flabby.

The adheren-
cy of the *Pe-
ricardium* to
the Heart for
want of Li-
quor to be
contained in
the *Pericar-
dium*.

On the other side the *Capsula Cordis* is sometimes found wholly destitute of any Water lodged in it, and the *Pericardium* closely affixed to the Perimeter or Convex Surface of the Heart by the interposition of many Membranes, which are hardly broken, and the *Capsula* not easily severed from the circumference of the Heart, which I saw some years since, in an Executed Felon, privately Dissected by dextrous Chyrurgeons of London, at the Hall, where Learned Dr. Needham, and many other Gentlemen were present.

The symptoms
of the Diseases
belonging to
the *Pericar-
dium*.

This Disease is attended with many dismal Symptoms, difficulty of Breathing, Synope, Lypothymy, Palpitation of the Heart, and a languid intermittent Pulse, which proceed from a small proportion of Blood received into the Ventricles of the Heart (and Lungs) by reason they cannot be expanded for the free admission of Blood, as enclosed within the narrow confinement of the *Pericardium*, compressing the Heart.

CHAP.

C H A P. XIII.

Of the Pericardium of other Animals.

THe *Pericardium* in greater and smaller Beasts, holdeth great similitude in Situation, Connexion, Figure, and Substance with that of Man.

The *Capsula Cordis* in more perfect Animals is made up of three Tunicles, The outward being fastned to the middle Coat by many fine Ligaments, is beset with many Cells, the allodgments of Fat.

The middle Tunicle, being somewhat thinner than the outward, is integrated of a great number of Fibres (finely spun, and curiously interwoven) which is interlined with a whitish *Parenchyma*.

The third Pellicle making the inside of the *Pericardium* in Beasts, is the thinnest of all the Coats, this I discovered in a Bullock to be furnished with many minute Glands, which I humbly conceive may be the Colatories of the Blood, transmitting its Serous parts into the Cavity interceding the *Pericardium* and Heart.

The *Capsula Cordis* in other greater Animals, as well as Man, hath a quantity of thin, transparent Liquor (seated in the empty space between the *Pericardium* and Heart, as in a Cystern) flowing out of the adjacent Glands.

The *Pericardium* of a Land Tortoise, is thick, as composed of many Membranes, and is sometimes distended with Wind, and most of all with a large proportion of thin, transparent Liquor.

A Lyon is furnished with a dense *Pericardium*, as made up also of many Coats, closely conjoyned to each other by the interposition of many thin Ligaments, and is most eminent for abundance of Fat, shading the outside of this useful Integument.

The *Capsula Cordis* in Birds is very thin, as being one Membrane (which is three in Beasts) made up, and curiously wrought with divers Fibrils, closely united, without any seam or visible commissure.

This fine Integument of the Heart in Birds, hath but a small space running between it and the Heart; So that it cannot contain any great quantity of Serous Liquor.

The Figure relating to the *Capsula Cordis* in Fish, is different from that of Man and other Animals, which is Pyramidal, but in Fish it is Triangular, as holding conformity to the shape of the Heart which is Tricuspidal, and endued with divers Angles.

The *Pericardium* of Fish hath great affinity with that of Birds, in reference to its fineness; and it is more close in Conjunction, than is found between the Integument and body of the Heart, in greater Animals; in most Fish it is Membranous, but in a Lamprey Cartilaginous.

Insects also as well as other Animals have a *Pericardium*, though in some it is scarce discernible by reason of its great thinness and close union to the Heart; whereupon it seemeth to be a proper Coat of the Heart.

The Hearts of greater and small Beasts, as perfect Animals, have their *Pericardium* free, as not conjoyned to the Diaphragm, as it may be seen in the

V V V V V V V

Pericar-

The *Pericardium* of greater and smaller Animals, hath great affinity with that of Man.

The *Pericardium* of a Land Tortoise.

The *Pericardium* of a Lion.

The *Pericardium* of the Heart in Birds.

The *Pericardium* of the Heart in Fish.

Pericardium of Man, to help the *Dia stole* of the Midriff, and in its Laxament to reduce it from a Plain to an Arch, which is more different in Man, by reason of his erect posture of Body.

CHAP. XIV.

Of the Heart.

The Heart is
the fountain
of Life and
Heat.

THe Heart being the most noble Machine motion, belonging to the excellent Fabrick of Man's Body, may be truly entitled the Sun of its Microcosm, from which the rays of Life, seated in the Blood, are displayed by Arteries into all parts of this little World; and in some sort may receive the appellation of the fountain of Life and Heat, as by its frequent repeated motions the innate heat, vigor, and spirit of the Blood, are conserved, and the gentle flame of Vestal Fire, the preservative of Life, is maintained.

And my intention is to treat first of its Structure (as the ground and foundation of its motion, afterward of its motion, as the use and accomplishment of this choice Machine consisting of variety of parts, disposed by the hand of the All-wise Architect in most Elegant order.

The upper In-
tegument of
the Heart.

The first part that accosteth our sight, after the *Pericardium* is stripped off, is its proper Integument, which is a thin, strong, and dense Tunicle, as made up of many Membranous close-struck Fibres (very curiously interwoven, in divers postures) whose Interstices are filled up with a *Succus Nutricius* or Seminal Liquor, adhering to the sides of their Coats in their first formation; whereupon they are rendred plain and smooth and easie to this choice Compag, as giving no discomposure to its outward parts in a constant and necessary motion.

This Tunicle, I humbly conceive to be the same with the thin outward Coat of the Arteries, which derive their origin from the Heart, and doth invest the Ventricles of this noble part as well as its ambient parts.

The use of the
Coat inve-
sting the
Heart.

As to its use it may be to give a great firmness to the Heart, as confining its spiral Fibres in their due seat, and to preserve the tender branches of the Coronary Blood-vessels, which sport themselves in numerous divarications through the substance of this fine Tunicle, overshadowing and encircling the Perimeter of the Heart.

The situation
of the Heart.

The situation of the Heart is generally conceived to be in the middle of the *Thorax*, which must be understood of its *Base*, and not of its *Cone*, which somewhat inclineth in Man toward the left side; and as to the length of the *Thorax*, the Base of the Heart is much nearer to the first Vertebre, than the Cone to the twelfth, and moreover the Base of the Heart is more distant from the upper Bone, than from the lower, the Sword-like Cartilage. And its Base may be more truly said to be placed in the middle of the *Thorax* in reference to its left and right side, and the upper region of the Base is equally

equally distant too in relation to the Sternon, as being measured by a right line; whereupon the Base will be found not to incline to either Extremity of the Sternon. And farthermore the Hearts of Brutes are seated more truly in the middle of the *Thorax*, than this of Man.

The Connexion of the Heart is made principally by the *Vena Cava* and *Aorta*, which fasten its Base to the backside of the *Thorax*, and it is tied also to the *Pericardium*, and Diaphragm by its interposition.

The Connexion of the Heart.

The greatness of this noble *Viscus*, is various in several Ages, and it hath greater dimensions in Man, if regard be had to the proportion of his Body, than in any other Animal, and it is commonly in Persons of mature age, six fingers longs, and four broad; and it hath been observed to be less, and more firm and compact in daring men of Eminent courage, than in Cowards who are said to have flabby great Hearts.

The dimensions of the Heart.

The Heart is adorned with a kind of Pyramidal Figure, as being more enlarged in its Base, and ending in a Cone, somewhat resembling a Pine Nut; and is not perfectly Orbicular, as being somewhat more depressed in its anterior and posterior Region, and more Protuberant on each side.

The Figure of the Heart.

The Surface of the Heart is for the most part smooth, only it hath some little inequality in reference to the Blood-vessels, which are divaricated through its Ambient parts, and admitteth some Asperities in relation to its Fat.

The Surface of the Heart.

This Noble Machine of Motion may be truly styled a Muscle, as being furnished with all its parts, disposed in a most Elegant order, and is Compounded of Carnous Fibres, Nerves, Tendons, Arteries, Veins, &c.

The Heart is a true Muscle.

This excellent Muscle being beautified with a kind of Circular Figure in point of its Circumference, and Pyramidal in reference to its length, is furnished with divers rank of Flešhy Fibres, which do not take their progress in right Lines but in oblique, before they are inserted into their Tendons, to give them the advantage of Contracting themselves with greater force, as making their approaches nearer to each other; whereupon the body of this Eminent Muscle groweth more strong, rigid, and tense, as being highly invigorated in its Contraction.

And in a well boiled Sheeps or Bullocks Heart, being divested of its Vessels and Auricles, a strong Tendon may be discovered, which encircleth the Margent about the right and left entrance into its Ventricles: Into this Tendon (as Learned Dr. *Lower* hath well observed) many Carnous Fibres (integrating the Ambient parts of the Heart) are Inserted with an oblique position.

The Tendon of the Heart into which many fleshy Fibres are inserted.

And not only the outward region of the Heart, but the inward recesses of the Ventricles too, are beset with Flešhy Fibres carried in Flexures, except some few Fibres, which climb directly upward through the outward surface of the Ventricle, and are inserted into the Base of the Heart.

The Ventricles of the Heart are beset with many Fibres.

The other Fibres which beset each Ventricle of the Heart, have a double rank and order, and are carried in a contrary progress, by reason the Fibres lodged under these right ones, do climb up obliquely from the left side to the right, and terminate into the Base of the Heart, and do very much resemble the winding Cavities of the Ear, in their Spiral Circumference.

The various Fibres of the Ventricles are carried in opposite Positions.

Other Fibres are also seated under the Ambient Fibres, which pass in an opposite posture to the former, and as the other treated of before, run from the left side toward the right; So these arise out of the right side of the Heart, and take their progress toward the left in oblique manner, and encircle both Chambers of the Heart, and ascend to the Base of the left side, and make

make many Spires in inverted positions, to those Fibres that proceed from the left side of the Heart.

Divers ranks of Fibres may be discovered upon the Excarnation of the Heart.

This extraordinary Muscle is made up of divers ranks of fleshy Fibres, which present themselves to our Eye one after another upon the Excarnation of a boiled Heart. The first rank appear as soon as the Tunicle is taken off, and these lodged more deeply cannot be discovered unless the Heart be divested of its outward row.

The Fibres do somewhat resemble a Skain of Thread.

The tracts and windings of these Fibres may be discerned as if we were led by a thread, as Learned Dr. *Lower* phraseth it; but by reason some threads being less fine, are wound into a Skain, and seem at the first sight, to resemble the complicated Fibres, not made up after the same order as threads in a Skain, but have very different Progresses, observing various methods, which very much thwart each other; So that the Tunicle of the Heart being removed, some may fancy that all Fibres of the Heart are carried obliquely from the Base of the Cone in one continued Duct; but upon a more curious search he shall find, that few of them do make half the length of the Heart, but a little space after they have arose out of the Tendon, they are reflected under the superior rank and then wholly disappear: And moreover it is remarkable, that the Ambient rank of Fibres are not all extended from the Base to the Cone of the Heart, but some of them, when they have arrived to the middle of its Circumference, or rather Length, are reflected in the manner of an Arch, and are inserted with an oblique Duct into the Tendon of the other side and Ventricle.

Most of the Fibres are reflected when they have the length of the Heart.

The right Ventricle being cut off, let us consider the Mechanism of the left, which in some sort holdeth Analogy with the right, and is different by reason the double rank of Fibres in the left Chamber of the Heart hath an inverted order terminating into opposite Tendons; because the outward Fibres being carried the whole compass of the Ventricle in the left side, do climb up with Spiral Flexures, and end into the Base of the Heart.

The double rank of Fibres of the left Ventricle, do terminate into opposite Tendons.

But the more inward Fibres of this Ventricle which have the same elongation with the outward in reference to the Cone, are carried in an opposite posture and ascend to the Base, and being inserted into its Tendon, do constitute the inward wall of this Chamber.

The external Fibres of this Ventricle do take their progress from the Base to the Cone. The several ranks of Fibres have different progresses.

And the external Fibres of this Cavity are not carried from the Base to the Cone, but quit their progress in the middle way, and creeping under the superior Fibres, do climb up obliquely to the Tendon of the opposite side.

And another rank of the Fibres having a contrary progress, do meet about the Cone of the Heart, and have mutual Convolution; So that the Fibres seated in the exterior wall of the left Ventricle, do rencounter those of the inward, about the Extremity of the Cone.

The different Fibres have one joyn-t-motion to lessen the Cavities of the Heart.

Whereupon it is very visible to a clear Eye, that the Fibres besetting the outward and inward wall of the left Chamber of the Heart to be continued, though they may seem to have a contrary progress, yet they all concur to accomplish the same motion, and do constring and bring inward the opposite Tendons, and by drawing themselves closer to each other, do lessen the Cavities of the Chambers of the Heart, and squeeze the Blood out of the right Ventricle into the Pulmonary Artery, and out of the left into the common Trunk of the *Aorta*.

Divers Fibres do end in the Flethy Columns.

And this is worthy our remark, That all Fibres do not terminate into the Tendons of the Margent, encircling the *Ostia* of the Chambers of the Heart, but many do end in the great Flethy Fibres, called Columns, which do emit many

many Tendons into the Mitral Valves, conjoyned with the Tendon lodged in the Base of the Heart.

And having discoursed the various ranks and Progresses of the Carnous Fibres surrounding the sides and walls of the Heart, it may seem not improper to treat of the Fibres enclosing the Cone of the Heart, which seem to be adorned with somewhat of a Spiral or winding Circular Figure, as resembling the circular motion of the Blood.

The spiral Fibres besetting the Cone of the Heart.

And as the inward Fibres of the Ventricle have a progress opposite to that of the outward, so the Fibres of the inward part of the Cone, proceed in a different method to the outward, as they are framed in spiral Circumvolutions about the Cone of the Heart.

And because the Blood is to be impelled out of the left Chamber of the Heart into the *Aorta*, and by smaller and smaller Branches into the most remote regions of the Body; Therefore Nature hath most wisely provided far more thick and strong Fibres for the left Ventricle than for the right, which protrudeth Blood only out of it into the adjacent parts of the Lungs.

The Fibres of the left are more thick and strong than those of the right.

So that if we truly survey the substance of the Heart, we shall find it not to be a *Parenchyma* holding similitude with that of the Lungs, Liver, Spleen, or Kidneys, the first being a system of Vesicles of Air, *Bronchia* Blood-vessels, and the other a company of innumerable Glands, as most of the *Viscera* are, being so many Colatories of the Blood, secreting it from its Bilious, Serous, or other kind of Recrements. But the Heart is a true Muscle of the same nature with those of the Limbs, as it is most manifest to Autopsy, if the Fleishy Fibres of the Heart be rendred more firm and compact by boiling, and then the Heart will appear to be an Organ made up of many ranks of strong Fibres adorned with a Prismatick Figure, of the same hue, consistence, and strength (as being united to each other by the mediation of many strong Membranes and Ligaments †) with those of the Limbs, and after the same manner are not capable to receive much greater dimensions in length, and its Fibres cannot be severed from each other at any great distance, without Laceration of the Membranes conjoyning the many rows of fleshy Fibres; and when they act, are rendred hard and tense, as having their ranks drawn closer together; whereupon the Compage of the Heart becometh more firm and rigid, and the Cavities of the Ventricles more narrow, whereby their Contents are discharged.

The *Parenchyma* of the Heart is different from that of the other *Viscera*.

The fleshy Fibres mutually conjoyned by Ligaments.
† T. 15. F. 1.
ff.
iii.

The Fibrous substance and constitution of the Heart, is different from that of other Muscles, as having a more solid, firm, uniform Compage, Coated with a more bright Red than the Fleish of other Muscles, which is more loose and flabby, whose more weak Prismatick Columns may be more easily disjoyned from each other by a less violent Laceration of their thinner Membranes.

The substance of the Heart is different from that of other Muscles.

Again, The Configuration of the Fibres of the Heart, is not the same with other Muscles, as not being truly equidistant, but crooked and spiral, full of many Circumvolutions surrounding each other.

The Fibres of the Heart are spiral.

Under the Coat encircling the Heart, is derived a rank of fleshy Fibres from the Base of the Heart, and from its Circular Tendinous substance, into which the *Vena Cava* and Pulmonary Vein do terminate in both Ventricles of the Heart; These outward ranks of Fibres do at first tend in a direct course toward the Cone, and afterward being variously Implicated, have a Retrograde progress toward the inward recesses of the Ventricles.

A rank of Fibres coming, the Base of the Heart and its Tendinous entrances.

The ranks of
fleshy Fibres
are tied to
each other.
† T. 15. F. 1.
iii.

† d d d.

The Fibres are
most great in
their Origins.

The inward
Fibres of the
Ventricles are
most large,
and the more
outward the
least.

The ranks of
fleshy Fibres
are mutually
conjoined by
strong Mem-
branes, Liga-
ments, and
Fibrous Bran-
ches.

† T. 15. F. 1.
iii.

The divers
empty spaces
of the fleshy
Fibres.

† T. 15. F. 1.
k k.

† F. 2. g g.
Ligaments
sprouting out
of the Tendon
of the left
Auricle.

Under this outward row of Fibres is seated other ranks, which are carried in oblique and spiral postures toward the Cone, and make many inter-
sections, being interwoven with divers other ranks of fleshy Fibres †, and
from thence are reflected toward the outward Compag of the Heart, with
winding Circumvolutions, and transverse Bandages; whereupon they
seem to Constitute the inward Columns, to which the Cords † of the Tri-
cuspidal Mitral Valves are affixed.

The most inward fleshy Fibres are most large near their Origins, as so
many Trunks adjoyning to the Tendons of the Auricles, and grow less and
less as they branch themselves in oblique or spiral Positions toward the Cone
of the Heart.

And after the same manner the most inward rank of fleshy Fibres seated in
the inside of the Ventricles are greatest and most strong, and the neighbour-
ing Lairs, as they more and more approach the ambient parts become less and
less in dimensions.

The Carnous Fibres are placed on each side of the Columns, and inter-
sect each other after the manner of Latise-work, and are firmly tied to each
other by strong Membranes, Ligaments and Fibrous branches †, which
keep the various ranks of Fibres close to each other, as mutual Auxiliaries;
So that they cannot part when they are engaged in a joynt action, produ-
cing the Systole of the Heart.

The *Area* or Interstices lodged between the interfections of fleshy Fibres,
are most of them Rhomboids, and some of them Oval, and others Paral-
lelograms †.

Many Ligaments do arise out of the Tendon (encircling some part of
the left Auricle near the Base of the Heart) and pass down the Wall rela-
ting to the left Chamber, and end in some few larger Ligaments, which are
sometime fastned about the top of a strong pyramidal Column, which I con-
ceive is made up of many fleshy Fibres, giving strength to the Ventricle, in
reference to Motion.

For the present, I will not treat of Arteries and Veins of the Heart, but
refer them to a subsequent discourse.

The Fibres of
the Heart de-
rived from
the recurrent
Nerves.

The upper
and greater
Cardiack Plex
proceedeth
from the *Par*
vagus and
Nerves arising
out of Inter-
costal branch,
according to
Dr. Willis.

The Heart is inched in every Region, with various Nerves and Nervous
Fibres, partly proceeding from the recurrent Nerve, which about the Nodes
of Reflection transmit many branches into the Posterior and Anterior Com-
pag of the Heart, as also into its Surface.

Whereupon it is adorned with two eminent Plexes distributed into it;
the upper and greater passeth between the *Aorta* and Pulmonary Artery, and
taketh its rise from great branches derived in each side from the *Par Vagus*;
And also many considerable Nerves of the Heart do arise out of the Inter-
costal branch; as Learned Dr. Willis will have it; which most Ingenious
Dr. Lower, very Skilful in the discovery of the Nerves (as having a curious
and dextrous hand in Dissection) denieth in these words; *Cum propagines*
nervosa à solo oetavi paris Neruo in Cor humanum inferantur.

These Cardiack Nerves have great Divarications through the numerous
ranks of fleshy Fibres, besetting the whole substance of the Heart, and are
inserted into the Walls relating to both Chambers, and into the outward Mem-
brane, every where encompassing and guarding this excellent Muscle of the
Heart.

C H A P. XVI.

Of the Auricles of the Heart.

THe right and left Ventricle of the Heart are adorned with an Auricle, as with two Appendages, and in truth are two little Hearts, as having peculiar Fibres, if not Blood-vessels, and Nerves, and are Auxiliary Muscles subservient to the greater Machine of the Heart, and are like two Servants waiting at the doors of the Chambers, to convey the Blood more readily into the greater Cisterns or Lakes of this rare Engine of Motion.

The Auricles
of the Heart.

The right Auricle is affixed to the right side of the Base of the Heart, and doth cover the termination of the *Vena Cava* (and not its Origins, as Great *Vessalius* conceiveth) which hath its length somewhat answering that of the right Auricle.

This Auricle is endued with somewhat of a Pyramidal Figure, as some will have it, because it hath an oblong Base ending into a more acute Cone, and is not far extended above the Base of the Heart.

The right Auricle of the Heart is endued with a kind of Pyramidal Figure. The Auricles when filled with Blood, have an equal Convex Surface, and when lank, have many Asperities or wrinkles.

The Base of this Auricle being distended with Blood, hath a Longitude far exceeding its Latitude, and its outward surface doth much vary according to its Repletion, by reason when the Auricle is distended, it is endued with an equal Convex Surface, and when it is rendred lank, as being emptied by the contraction of its Fibres, the Surface is full of roughness, as endued with many wrinkles, and its Surface is outwardly bedewed with watry Liquor, in which it is akin to the ambient parts of the Heart.

The inward surface of this Auricle, encircling its Cavity, holdeth great Analogy with that relating to the Ventricles of the Heart, and is smooth only where the *Vena Cava* doth terminate, and for the most part is rough and full of Furrows, as consisting of many implications of Carnous Fibres; So that it seemeth in some sort to outdo the Ventricles in eminent Asperities, and the dimensions of the Auricles are rendred greater or less, as distended or emptied of Blood.

And hath its Connexion after this manner, as I humbly conceive; The left side of its Base is conjoyned to the Confines and extreme parts of the substance of the Heart, where the anterior Region of the *Vena Cava* is lodged in the right *Sinus*, and the right side of the Base is connected to the body of the *Vena Cava* (according to the length of its insertion into the Heart) to which the Auricle is so united in its Anterior Region, as it seemeth to make one body with it, and in all other parts the Auricle seemeth to be free from all Connexion, and is lodged as well as the body of the Heart within the Confines of the *Pericardium*, to which it is no where affixed by the interposition of any Membrane.

The Connexion of the right Auricle.

The left Auricle of the Heart is in conjunction with the termination of the Pulmonary Vein, and is adorned with a kind of Pyramidal, or rather Oval † Figure, whose Cone is more acute than that of the right Auricle, and is not carried upward (as is the Cone of the other Auricle) but bendeth somewhat sidewise toward the left.

The Connexion of the left Ventricle.
† T. 15. F. 1.
b b.

The left Auricle in persons of more mature years, or rather in old age, groweth much less in dimensions than the right Auricle and the Orifice seated

The left Auricle is lessened in persons of old age.

seated in the termination of the Pulmonary Vein (to which the left Auricle is conjoyned) which is more narrow than that of the Termination belonging to the *Vena Cava*, to which the right is affixed.

The outward Surface of the left, when rendered turgent with Blood, is like the right Auricle in its smooth Convex Figure, and the left doth very much resemble the other in its inward Surface as furnished with many Furrows and Roughnesses.

The left Auricle is very like the right.

The left Auricle also observeth much Analogy with the right in its Connexion, by reason as the right is conjoyned to the termination of the *Vena Cava* in one side, and to its Body in the other, so the left Auricle in the right side of its Base is tied to the substance of the Heart near the egress of the Pulmonary Artery, and in the left side of the Base of the said Auricle to the body of the Pulmonary Vein.

The Vessels of the Auricles.

The Auricles are accommodated with Arteries, Veins, and Nerves, of which the last are divaricated through the substance of those Muscles before they enter into the body of the Heart, and are derived from the *Par Vagum*.

The fleshy Fibres of the Auricles.
† T. 15. F. 1. b b.

The Auricles are furnished with many ranks of fleshy † Fibres, from divers Muscular Columns, very much resembling those in Figure, which are lodged in the Ventricles of the Heart: These intermedial Fibres are carried with an oblique course, and are inserted into the opposite Tendons, by reason they being seated in the Base of the Heart, are also imparted to the Auricles, and upon these Tendons the fleshy Fibres do rest as upon a Prop, or Fulcrum; And on the other side, the right Auricle, where it is concerned with the *Vena Cava*, is guarded with a hard Tendinous Circle, into which the fleshy Fibres are implanted.

The use of the Auricles of the Heart.

Now I will discourse somewhat of the use of the Auricles, and respite the greatest part till I treat of the Motion of the Heart, and compare the Auricles with the Ventricles; wherein it may be observed that the Auricles have not the same Analogy which passeth between the Ventricles, moving together with equal pace, by reason a greater proportion of Blood ought not to be impelled by the contraction of the right Ventricle into the Pulmonary Artery, than can be received out of the Pulmonary Vein into the left Chamber of the Heart; So that an equal quantity of Blood must be entertained into both Cisterns of the Heart, and thence be distributed by a due measure through the Pulmonary Artery into the substance of the Lungs, and by the *Aorta* and its Branches and Ramulets, into all parts of the Body.

The Cavity of the right Ventricle is more large.

The motion of the Blood being so constant and orderly in the Ventricles, it may be worth our disquisition, why the Auricles do not observe the same Analogy with each other in dimensions, which Nature ordained (as I humbly conceive upon this account) by reason the current of the Blood is more slow out of the *Vena Cava* into the right Ventricle; therefore it is requisite that the Cavity of the right Auricle should be more enlarged, as receptive of a larger proportion of Blood, thence to be injected into the right Ventricle, sufficient for its Repletion; by reason the Blood in Expiration is more speedily squeezed by the pressure of the Lungs out of the Pulmonary Vein into the left Ventricle; whereupon the motion of the Blood is more highly accelerated, and therefore a less Cavity will suffice in the left Auricle.

C H A P. XVII.

Of the Ventricles of the Heart.

HAVING discoursed of the outward Walls of the Heart, it may be fit now to shew you the inward Recesses and Chambers, commonly called the Ventricles, the one being seated on the right, and the other on the left side, as the Cisterns of Vital Liquor, from whence transmitted by the one into the Lungs, and by the other into the great Artery, and afterward by smaller and smaller Branches, into all parts of the Body.

The right Chamber of the Heart hath thinner Walls, and a more large Cavity than the other, and is endued, not with a round, but rather a Semicircular Figure, not extending it self to the Cone.

The right Ventricle of Heart.

This Ventricle in its right side is adorned with a Convex, and its left with a Concave figure.

The Orifice of the *Vena Cava* transmitting Blood into the right Ventricle, is guarded with a Membranous Circle, divided into three Valves looking inward, commonly called *Tricuspides* from their Triangular figure, as some imagine, though in truth they are not endued with this shape, but have the appellation of *Tricuspides*, by reason each of them hath three Fibres, as so many Ligaments, by which they are fastned to the fleshy Columns, relating to the *Septum* of the Heart.

The Tricuspidal Valves.

These Valves give way to the stream of Blood, coming out of the Orifice of the *Vena Cava* into the Cavity of the right Ventricle; and do hang pendulous, as some conceive, in the Contraction of it, to shut up the termination of the *Cava*, to intercept the Retrograde motion of the Blood into it.

The Wall of the right Ventricle is much thinner than that of the left, and narrowed only with a Semicircular Contraction according to its Figure; whereupon the Furrows of this Ventricle are more shallow, and the Carnous Fibres more small, as being an Appendage of the other more strong Ventricle; And least the right Chamber of the Heart, having a slight enclosure, should be overmuch distended by great Rivulets of Blood beyond its due tone; So that the Carnous Fibres should be so far weakned, as not to be able to Contract themselves in order to discharge the troublesome current of Blood into the Lungs; Nature hath wisely framed a round Muscle about its middle Region, proceeding from the *Septum Cordis*, which is very conspicuous in the Heart of Brutes, and in that of Man three or four Fibres may be discovered, which supply the place of this Muscle found in the Heart of some other Animals.

The right Ventricle is much thinner than that of the left.

Before I quit the discourse of the right Ventricle, I deem it convenient to speak somewhat more of the fine Valves seated near the Orifice of the *Cava*, and to consider their Mechanism (in which their use may be seen.) That their *Papillæ* or Columns are rendred Prominent beyond the Surface of the inside of the Ventricle, and that some of these Valves are seated in the opposite side, and that the Columns are placed in a side opposite to the Membranes to which they are affixed; as Learned Dr. Lower, hath observed.

The Valves are seated near the Orifice of the *Cava*, and fastned to the Carnous Columns.

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The Fibres of the Columns are relaxed, and the Valves extended in the Systole of the Heart, according to some Anatomists.

The Columns having this Fabrick, are so seated, that the Membranes might keep some distance from the sides of the Ventricle, that they being lifted up in every Systole of the Heart (by reason the Fibres of the Columns are relaxed) might hang crosswise in the middle of the Ventricle, and being beaten backward by the Retrograde motion of the Blood, they might be so expanded, that the extended Membranes might shut up the recourse of the Blood into the Orifice of the *Cava*, as some Learned Authors have observed. And if these Tricuspidal Fibres should immediately arise out of the sides of the right Ventricle, and lean closely upon the inward surface of the Heart, they could not be receptive of the recourse of the Blood, and thereby be elevated; whereupon the Viral Liquor would return by the same passage it was admitted into the right Ventricle, and so frustrate the design of Nature in order to transmit Blood into the Pulmonary Artery, to make good the Circuit of Blood through the Lungs into the left Ventricle.

The Cone of the Heart is not brought toward the Base in its Systole, but the sides of the Ventricles are brought nearer to each other.

This Hypothesis is grounded upon the drawing the Cone toward the Base of the Heart in its Systole, whereby the Ligaments of the Tricuspidal Fibres are conceived to be relaxed, and the Membranes expanded; but with deference to these Anatomists, I humbly conceive it more consonant to Autopsy, that the sides of the Ventricles are brought nearer each other in the Systole of the Heart (and not the Cone to the Base) So that the Ligaments of the Valves are not relaxed, and the Membranes distended, but the Valves every way encompassing the Orifice of the *Cava*, have their inward Cavities contracted and rendered close by having the sides of the Membranes nearly to meet each other by the Systole of the Heart; So that the Valves become as Damms intercepting the current of Blood in its motion toward the entrance of the *Cava*, and promote it toward the Orifice of the Pulmonary Artery, in order to import it into the Lungs.

The use of the Tricuspidal Valves.

Hence the use of these Tricuspidal Valves may be easily discovered if the fleshy Columns, swelling out of the side of the right Ventricle, be curiously considered; and an injection of Liquor being made into it by a Wound, you may discern by the contraction of the Membranes a Damm to be made at the Orifice of the *Vena Cava*, upon the motion of the Injected Liquor towards it.

The mixture of Chyme with Blood in the right Ventricle.

These Valves also giving a check to the Retrograde motion of the Blood, do make a greater mixture of the Chyme with the Blood when it is dashed against these Membranes, and so forced by the Systole of the Heart toward the Orifice of the Pulmonary Artery.

The left Ventricle is endued with a Pyramidal Figure.

Having given some account of the right, I will now endeavour to shew you a prospect of the left Ventricle, which taketh its rise in a large Base, and Gradually Terminates into a Cone, somewhat resembling that of the Heart; And as to the inward surface of the Ventricle, it is adorned with an Orbicular Figure, by reason the *Septum*, (relating to the inward Recesses of the Heart, seated in the left side, where it formeth the right side of the left Ventricle) is endued with a Concave Surface, and not with a Convex, as it is found in the right Chamber of the Heart.

The left Ventricle hath greater dimensions than the right.

The left Ventricle is encircled with a round Wall of an equal thickness, and less in compass in point of Latitude, and greater in length, than the right Ventricle.

The left Chamber being consigned by Nature to a stronger impulse of the Blood, as it is imported by the great Artery, and its greater and less Branches into the remote parts of the Body, doth very much exceed the right Ventricle

Ventricle in the thickness of its Walls, and greatness and strength of its fleshy Fibres; and the Carnous Columns and their appendant Membranes, do much transcend the like furniture of the right Ventricle in largeness and firmness; by reason as the Vibration of the left Ventricle is much more impetuous in the Systole, so it is requisite it should have greater fleshy Fibres, as stronger instruments of motion to sustain the vigorous Pullations, made by strong contractions of the Walls, encircling the left Ventricle; in order to throw the Blood into the Orifice of the *Aorta*, and least the Vital Liquor should have recourse again out of the common Trunk of the great Artery into the left Cystern, and out of it into the Lungs.

The thickness of the Wall of the left Ventricle exceedeth the right, and is furnished with stronger Fibres.

The Great and All-wise Architect hath appointed three Membranes adorned with a Semicircular Figure, stopping the Orifice of the Pulmonary Vein, and that of the *Aorta*; So that the Blood by the interposition of these Fludgates cannot have any reflux out of the left Ventricle into the Lungs, nor out of the *Aorta* into the neighbouring *Sinus*.

The left Ventricle is accommodated with far greater Muscular Fibres, and deeper Fissures than that of the right, that the Walls of the Heart might be more strongly contracted in its Systole, that the inward Surfaces of the Ventricles might be brought nearer to each other; and therefore Nature hath assigned more deep Furrows to the left, because more strong Vibrations are requisite in this *Sinus* to impel the Blood more briskly, first into the common Trunk, and thence into the ascendent and descendent Trunk of the *Aorta*, and by their branches, into all regions of the Body.

The left Ventricle hath deeper Furrows than the right.

And because the Walls of the left Ventricle are chiefly made up of oblique Circular Fibres, which are every way contracted into themselves to make the sides of the Ventricle to meet, which could not be so closely performed, and the inward Surfaces of the left *Sinus* be brought so near to each other, unless these deep Fissures were fitted for this motion.

The reason of the deep Furrows in the left Ventricle.

In the left Ventricle are seated the Mitral Valves, which in truth are Membranes, akin to the Tricuspidal Valves, and are endued with no regular Figure, whose Margents are waved into various inequalities, no ways resembling a Mitre; and do encircle the Orifice of the Pulmonary Vein †.

The Mitral Valves do not compass the Pulmonary Veins.
† T. 15. F. 1. ccc.

The Carnous Columns † seated in the left Ventricle, are adorned with a Pyramidal Figure, whose Bases encline toward the Mitral Valves, and their Cones toward the Cone of the Heart.

† T. 15. F. 1. cc.
The Carnous Columns are endued with a Pyramidal Figure.

The Ligaments springing out of the heads of the fleshy Columns, have two, three, or more Branches inserted into the Mitral Valves †.

† T. 15. F. 1. d d d.
The use of the Mitral Valves.

The use of the Mitral Valves is, to hinder the Retrograde motion of the Blood out of the left Ventricle of the Heart, into the Pulmonary Vein, as the Mechanism of the Valves doth clearly denote, as they every where immure the Orifice of the Pulmonary Vein †, which is shut up close when the sides of the Valves are brought near each other by the compression of the Walls of the left Ventricle in the Systole of the Heart, wherein the Reflux of the Blood is intercepted (by the closely-conjoyned Membranes of the Valves) into the Pulmonary Vein, and the Blood impelled into the open entrance of the *Aorta*, to make good the motion of the Vital Liquor into all parts of the Body.

† T. 15. F. 1. ccc.

The Semilunary Valves lodged in the left Ventricle of the Heart are partly made up in its lower Region of many Semicircular Fibres, and in their upper with many right fine Fibrils, filling up the Surface of these Valves †, which

The Semilunary Valves of the left Ventricles.
† T. 15. F. 2. d d d.

† T. 15. F. 2.
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The use of the
Semilunary
Valves lodged
in the left
Ventricle of
the Heart.

which are three in number (encompassing the Orifice of the great Artery, of which the greatest is seated in the middle †).

The use of these fine Valves is to hinder the recourse of Blood out of the Orifice of the *Aorta* into the Cavity of the left Ventricle, which may be clearly proved by the structure of the Valves, which being Concave bodies (seated in the entrance of the great Artery) are receptive of the Blood entertained into the *Aorta*, and moving toward the left Ventricle; So that Blood being detained in these Valves, as so many Receptacles, doth impede its motion backward toward the left Chamber of the Heart, and at the same moment the Cavity of the *Aorta* being straightned by many Circular Fibres, doth impel the Blood more and more forward toward the ascendent and descendent Trunk of the *Aorta*, to promote the Circulation of the Purple Liquor into the several Apartments of the Body.

The use of the
Semicircular
and right Fi-
bres relating
to the Semi-
lunary Vavles.

When the Blood is received out of the left Ventricle into the Cavity of the *Aorta*, Nature hath provided Semilunary Valves affixed to the mouth of the great Artery) which do detain some parts of the Blood beaten back by the Pulsation of the Arteries in their Cavities, as so many Membranous Cells beset with divers Semicircular and right Fibres, which do Contract themselves and narrow the hollowness of the Semicircular Valves, and help to impel the recoiling Blood forward into the common Trunk of the great Artery, and afterward into the greater and smaller Arterial Branches, to give Life and Heat to all regions of the Body.

CHAP.

C H A P. XVIII.

Of the Motion of the Heart.

THe Heart is the most noble piece of Household-stuff, belonging to the middle Apartment, as it is a rare Machine of Motion (ordained by Nature to make good the Circulation of Blood, the great Preservative of Life;) whereupon it may justly claim to it self a Prerogative of being the chief Muscle of the whole Body as it is in perpetual motion, and thereupon hath most strong Carnous Fibres, considering its small bulk; So that its Flesh is very solid, firm, and uniform, tinged with a bright Red, and its Prismatic Columns are so strongly conjoyned that they cannot be easily severed from their Membranes, and numerous Tendinous Fibres; And above all, the fleshy Fibres of the Heart are so linked together, in each Ventricle, that they will hardly admit any separation.

The Heart is
a Machine of
Motion.

And moreover, the Fibres of this rare Engine of Motion, being as it were so many minute Muscles, have a different disposition and configuration from those of other Muscles, as they do not run in parallel, but more irregular Lines, as variously intersecting each other sometimes in Obtuse, and other times in right Angles, and make their progress in various positions, *vid.* right, oblique, transverse, and spiral.

The Fibres do
not always
run parallel,
but in irregu-
lar Lines.

The Walls belonging to the Chambers of the Heart, are framed of divers ranks of Carnous Fibres (as so many Machines of Motion) seated one above another, which are not only affixed to each other by the interposition of strong Membranes or Ligaments; but are also firmly, and mutually tied by the mediation of fleshy Fibres.

The Walls of
the Heart are
made of di-
vers ranks of
Fibres.

This curious Fabrick of the Heart is contrived with wonderful Artifice, speaking the infinite Wisdom of the Grand Architect; and under the Membrane immediately encircling the Heart, and from its Base, and from the Tendinous Circular Orifices (in which the *Vena Cava*, and the Pulmonary Vein do Terminate) and from the Origins of the *Aorta*, and Pulmonary Artery, is propagated a rank of fleshy Fibres, which observe a kind of equidistance from each other, and passing in right Lines toward the Cone, where they being variously interwoven, are reflected toward the inward Walls of the Ventricle: Under this outward row, are seated other more inward ranks of fleshy Fibres, running in oblique and spiral postures, which tending toward the Cone, do bend backward before they arrive its point, and decussate each other with various Plexes, and afterward do pass inward in oblique and spiral wreaths, (being in conjunction with many ranks) toward the Base of the Heart, and do partly make the inward Columns of the Ventricle, to which the Ligaments of the Tricuspidal and Mitral Valves are affixed; and the most inward ranks of these strong fleshy Fibres do integrate the Walls of the right and left Chambers of the Heart.

The first rank
of fleshy Fi-
bres, and their
progress.

Their inward fleshy Fibres are large, like so many Trunks where they are implanted into the Tendon about the right Auricle near the Base of the Heart, and afterward grow less and less, as they branch themselves in oblique and spiral positions toward the Cone.

The inward
fleshy Fibres
of the Heart.

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The

The most inward rank of Fibres are the greatest.

The most inward Lair of Carnous Fibres have greatest Dimensions, and the next ranks grow smaller and smaller, as they more and more approach the Circumference of the Heart, and all the rows of Fibers are curiously interwoven, and strongly tied to each other by many Ligaments and fleshy Fibres, which I have often clearly viewed upon Dissections: Whereupon the many ranks of Fibres being firmly and mutually conjoyned, do joyntly assist each other as one Compag, in order to move the Heart, which is made inward toward the Center, in which the most strong Fibres are seated, as most able to Contract the Ventricles of the Heart, and make the more brisk impulse of the Blood into the Origens of the Arteries.

The Area of the fleshy Fibres are adorned with various Figures.

The Area, or Interstices of the fleshy Fibres (interwoven with each other in a kind of Network) are endued with variety of Figures, some resembling Rhomboids, others Prismes, a third Ovals, and a fourth have several irregular shapes, and different magnitudes.

The fleshy Fibres are beset with many small Pores.

And these fleshy Fibres have not only divers empty spaces interceding their numerous interfections, and Plexes, but the Fibres themselves are beset with numerous minute Pores, capable to receive Vital Liquor, which distendeth the Compag of the Fibres, rendring it tense and rigid.

Borellus his Illustration of the Motion of the Heart Mechanically, by a Clue of moistned Thread,

Learned Borellus, a great Master of Reason, as highly versed in the Mathematicks, hath Mechanically Illustrated the Motion of the Heart, made up of divers spiral Fibres, by a Clue or Rope, consisting of many Threads, spirally interwoven, as he hath it *Lib. 2. de motu Animalium, Cap. 1. to p. 95. Propos. XLIII. Si glomus compositus ex fibris aque crassis ac similis consistentie concentricis, sive spiraler in volutis circa Vesicam inflatam, ut habeat cavitatem intermediam. Dico quod si per humectationem filorum cavitatis glomi repleatur, spirae internae glomi necessario Corrugari debent, remanentibus externis tensis*; If a Clue be composed of many threads of equal greatness and consistence, concentrically or spirally wreathed about a Bladder blown up, that it may have an intermedial Cavity; I say, That if by the moistning of the threads, the cavity of the Clue be filled, the inward spires of the Clue must necessarily be Corrugated, the External remaining tense.

And that this Hypothesis may be more clearly understood, a Rope may be Diametrically cut, out of which being dry, a Circular Zone will arise, as framed of Contiguous spiral, or Concentrick threads; But in a wet Rope cut through the Axis, a Circle will appear, consisting of tense Corrugated threads, which being of an equal bigness and consistence, as equally Porous, do obtain a proportionable Tenseness and Corrugation, as filled with the like measure of drops of Water.

The ambient parts of the Rope made up of many Threads, are not easily capable of disunion, by reason the Threads cannot be extended in length, as closely lodged within each others embraces in Spiral Wreaths, and is filled with watry drops insinuated into their Pores; whereupon they are so strongly Contracted, that they resist, as if they were encircled with Iron Hoops the Renitence of the inward distended parts; So that though the outward threads of the moistned Rope be filled and thickned, yet they do not render their tense Surface more Prominent and Convex, as having their outward confines strongly bounded by Spiral Wreaths of numerous Filaments variously intersecting each other, which give a check to the swelling or expansion of the outward Walls, or Perimeter of the Rope; So that the Compag of the more inward threads must necessarily acquire greater dimensions, and the more internal ranks of threads are more and more forced inward as they approach nearer and nearer to the Center of the Rope, and fill up the Cavity of it.

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The outward rank of Filaments making the circumference of the wet Rope, doth remain rigid, without any greater expansion of its Convex Surface, as not obtaining a more elevated Protuberance; but the subsequent or second rank of moistned Threads, doth not observe an equal tenseness with the Ambient, but as being puffed up with watry Particles, and not having their Convex Surface more Dilated, must of necessity bend inward, when their Threads are Corrugated, as shortned in divers parts, thereby filling up the cavity of the Rope tending toward the Center, as the Concave Surfaces lodged within the Flexures of the outward rank of shortned Filaments do approach and encircle the Convex Surface of the more inward rank; whereby the various ranks of Filaments seated one within another, as they become Contracted by having their innumerable Pores stuffed with watry Particles, do more and more promote their course inward as they come more and more nearly toward the Center, till the inward cavity of the Rope is wholly filled up by the various Corrugations of the moistned Filaments.

The outward Perimeter of the Rope observeth the same dimension in Motion.

Whence it may be inferred with good reason, That the inward spires of the Clue are affected with unequal Corrugations, as they have more Flexures, whereby they nearer and nearer approach the Center of the Rope, which I humbly conceive is accomplished upon a double account: First by reason the more outward ranks of Threads, being great with liquid Atoms do Contract themselves inward, and do press the next subsequent ranks more and more toward the Center of the Clue; and secondly, The spiral rows of Filaments lodged near the Center, have their Pores more distended with watry drops, and are thereupon contracted into more Flexures, as they come nearer to the Center of the moistned Rope.

The inward Spires of the Rope are affected with unequal Corrugations as they come near the Center.

And upon these Premises it may be farther proved, That the external Figure of the moistned Clue, retaineth the same Position, as not being Expanded nor Contracted; and first of all the Threads of which the outward face of the Clue is composed, cannot be Dilated, as not being capable of a farther extension in length, and as being closely and strongly conjoyned in Spiral Wreaths, in manner of a Rope, which being moistned, its twisted threads are so firmly bound together in the Circumference, that they will not give way, that their Convex Surface may admit a farther Expansion or greater Protuberance. Secondly, The outward threads of the Clue cannot be Contracted, by reason the Compage of the inward Filaments is rendred tense and rigid, as having their Pores highly filled with watry Particles; that the inward ranks of Threads by their great stiffness and renitence, do so bear up the most outward, that they will not admit them to bend inward, and thereby make a variation of the Figure of the Heart.

Farthermore, to make the Instance more applicable to our purpose, I will take the freedom, with your permission, to make this addition, That a hollowed Rope is made of many Flaxen Threads, Spirally interwoven, and that the outward rank of Spires, admitteth no change of Figure, while the more inward rows grow big by having the Interstices of their Threads filled with watry Atoms; and by reason the inward ranks when distended, cannot freely Dilate themselves toward the outward Perimeter of the Rope, they are forced inward, and are Corrugated into many small Flexures, which are rendered more and more numerous, as they come nearer and nearer to the Center; So that the variously Contracted Threads of divers inward ranks, do make their progress more and more inward toward the Center, till they wholly fill up the cavity of the Rope, while the Figure of the utmost rank of Threads, admits no alteration of Figure, either by a greater Expansion or Contraction.

The

The Analogy between the Heart and the Rope in reference of the fleshy Fibres endued with spiral Lines.

A second Similitude by reason of the numerous Pores of the fleshy Fibres. The third likeness, by reason their outward Circumference is not altered.

A fifth likeness between the Fibres of the Heart, and the Filaments of the Rope.

The sixth Analogy between them.

The Walls of the Heart are brought nearer to each other by Pulsation.

The Heart as it hath a curious Compage, made up of various ranks of fleshy Fibres, encircling the cavities in many spiral lines, holds great Analogy with a Clue or Rope composed of many rows of Threads, which being Spirally twisted with each other, do enclose a hollownes, lodged in the inward parts of the Rope.

Again, The Fibres of the Heart are beset with numerous Pores as well as the Threads of the Rope with many Interstices, capable to be filled up (as being both spongy Bodies) with a great company of liquid Particles.

A third Similitude intercedeth the Perimeter of the Heart, and that of the Rope, that their Figure is not receptive of any alteration, as acquiring greater dimensions by Expansion, or lesser by contraction, when the inward ranks of the Fibres of the Heart, and the rows of Filaments, relating to the Rope, have their innumerable Pores swelled with Liquors.

A Fifth likeness may be said to pass between the ranks of Fibres of the Heart, and the rows of Threads, Integrating the Rope, that when their Interstices are big with many liquid minute Bodies, they do not vary the Convex Surface of the Heart or Rope, but their several inward ranks do make their progress toward the Center.

A sixth Analogy, that runneth between the inward Lairs of the Fibres of the Heart and the Threads of the Rope, is, that both of them, when rendered tense and rigid with liquid Particles (insinuated into their spongy substances) do more and more contract themselves, as they come nearer and nearer to the Center; which I humbly conceive may be fetched from a double cause; the first may be this, That the first rank of inward Fibres is pressed first by the outward Lair, which doth not give way, whereupon the subsequent rank is drawn inward by the renitence of the outward, and afterward the inward ranks being so many Auxiliaries tied to each other, do more and more protrude each other by their many Contractions which are most vigorous toward the Center. A second reason may be taken from this, That the most inward ranks of Fibres have their Pores most highly filled with most small liquid Bodies, and thereupon they most briskly Contract near the Center, and do joyntly and perfectly close on each side and wholly fill up the Cavities, relating to the Heart.

This curious Machine of Motion is strongly affixed in its Base, to the Back, by great Trunks of the *Vena Cava* and *Aorta*, (adjoyning to the Vertebres) by whose interposition the Base of the Heart is kept firm and fixed, as not disjoyned from the Back in its repeated Pulsations, which are exerted by many ranks of strong fleshy Fibres, seated within each other in elegant order, and mutually tied by the mediation of many Ligaments, and the intercourse of various Fibres, wonderfully interwoven, and strengthening each other; So that they are mutually assistant in joynt Contractions, whereby the Cavities are more and more lessened, as the Walls of the Chambers of the Heart are brought nearer and nearer to each other, till a perfect closure of the sides of the Ventricles are made, and their intermedial hollow Spaces wholly taken away.

The rare Compage of the Heart much resembleth a Clue or Rope, as made up of many Lairs of innumerable Fibres (interwoven in Spires; So that they cannot be extended in length into right Lines) implanted into strong Annular Tendons, as so many Hypomoclia, or Centers of Motion; and the Terminations of the most inward rank of Fibres are mutually tied to the Concave Perimeter of the Heart.

The

The Fabrick of the Heart, as an Engine of Motion, is composed of many Lairs of Fibres running in Spiral Lines, which render them strong, as composed of many Segments of Circles, wherein the crooked Fibres by doubling their point, do obtain a new Center, and gather up their parts into many narrow Circumferences, whereby they have them strongly united, and do make more brisk Contractions toward the Center of the Heart:

The reason why the Fibres of the Heart are Spiral.

The spongy substance of the fleshy Fibres, is receptive of numerous drops of Blood, which are insinuated into their innumerable Pores, whereupon the Compage of the Fibres groweth big, tense, and rigid, (after the manner of a Clue or Rope, whose Pores and Interstices of innumerable Threads, are filled up with a great number of drops of Water) whereupon the Fibres (being irritated by the distention of their Compage) do endeavour a freedom from their burden, by Contracting themselves, not by bringing their Extremities toward their Middle, (as it is effected in the motion of other Muscles) but by drawing the Muscular Fibres of each side of the Heart inward, by a mutual Approximation, in order to which the Columns and other Fibres (seated in the inside of the Heart) do most strongly Contract toward the Center, as being the largest, and highly distended with more numerous drops of Blood, then the more small Fibres (placed more remote from the hollow Perimeter of the Heart) which do Contract more faintly, as being smaller and less tense, and more remote from the Center.

The fleshy Fibres being spongy, grow big with Blood, and thence are irritated to Contract.

The Heart may be said to be composed of many Muscles, as integrated of several great fleshy Fibres, and every one of them is made up of Veins, Arteries, Nerves, and many Carnous and Tendinous Fibrils, making up a Muscular Compage encircled with a proper Coat, into which many Tendinous and Nervous Fibrils are inserted; whereupon a great source of Blood being impelled into the Cavities of the Heart, is dashed against the Coats of the fleshy Fibres, beset with numerous Fibrils, which being irritated by a quantity of Blood highly compressing them, do more and more Contract themselves toward the Center, till the walls of the Heart mutually closing, do squeeze out the Blood into the Origins of the Pulmonary Artery and common Trunk of the *Aorta*, whence it is transmitted into all parts of the Body, as their great Preservative.

Many Tendinous Fibres are inserted into the Carnous.

To give a more full account of the manner of its motion, I humbly conceive it is not accomplished by drawing the Cone of the Heart toward the Base, but by the mutual conjunction of the Sides, relating to the Ventricles of the Heart, and not by lessening the length of the Heart, which may admit a proof Mechanically, by reason if the *Mucro* and Base be drawn toward the Middle, it must be performed by a multitude of fleshy Fibres implanted into each Extremity; of which the Base is wholly destitute, and the Cone hath but few inserted into it, by reason most of the Fibres tending toward the Cone, do not arrive it, but are reflected toward the Ventricles, into which they Terminate.

The motion of the Heart is made by drawing the insides of the Ventricles close to each other.

Another Argument may be brought against the Motion of the Cone toward the Base, because almost all Fibres of the Heart, which are very numerous, are carried either obliquely or transversely about the sides of the Heart, which are beset with many Lairs of Fibres, mutually conjoined by

the interposition of strong Ligaments, and by the intercourse of Fibres, which mutually unite their several ranks; So that when the Fibres grow tense and rigid by the free reception of drops of Blood through their fruitful Pores into their inward Compage, the intermedial spaces of the Fibres are lessened; and seeing the bodies of the Fibres being enlarged in dimensions, cannot have recourse outward, as being confined by the ambient parts of the Heart not capable to have their Convex Surface dilated; the distended Fibres must of necessity be more and more drawn inward, as they approach the Center of the Heart, till the Concave Perimeter is first lessened and then taken away to discharge the Blood into the Orifices of the adjoining Arteries, for the support of the whole Body.

The Septum
of the Heart
being thick
is not easily
Contracted.

Farthermore, the *Septum* or Partition-wall of the Heart, being thick, is not easily Contracted as made up of many Spiral Fibres, which hinder the motion of its Extremities toward the Middle; So that it is more easie, according to the Mechanism of the Heart, for the Walls by approaching each side of the *Septum* to lessen the Cavities of the Ventricles, than for the Extremities of the *Septum* to be drawn toward the Middle.

Farthermore, to illustrate this discourse of the Motion of the Heart, I will add, that the outward Perimeter of the Heart being not alterable, as guarded with a multitude of Spiral Fibres, and the more inward ranks acquiring greater dimensions, by having their spongy substance distended with the reception of a quantity of Blood, must be drawn inward by making more Corrugations, as they approach the Center; whereupon the sphere relating to the Ventricles of the Heart, must be lessened, as being filled up by the enlarged Fibres of the Heart, which being inwardly imitated by a large proportion of Blood imbibed into their inward Recesses, and outwardly by a compression made by a current of Blood bearing upon the Walls of the Heart; do often Contract inward appearing in repeated Vibrations to ease their Intrals and outward Surface from a load oppressing them, by discharging it into the neighbouring Vessels.

The Cavities
of the Ven-
tricles are
lessened in the
Pulsation of
the Heart.

And it is very conspicuous that the Motion of the Heart is exerted by fleshy Fibres moving in several ranks toward the Center (by various Corrugations straightning the inward Perimeter of the Ventricles,) by making an Incision into the Ventricles, whereby a Finger being immitted into either of them, is highly pinched by the strong Contractions of the fleshy Fibres, more and more approaching the Center; And it is also agreeable to Ocular demonstration, that at the same time when the divers ranks of fleshy Fibres are carried more and more inward in various Flexures toward the Center, to lessen the Cavities of the Ventricles, that the outward Perimeter of the Heart is neither Distended nor Contracted, which I plainly saw in a Dog Dissected alive in the Theatre of the Colledge of Physicians in London.

The motion of
the Heart is
performed by
Carnous and
Tendinous Fi-
bres.

And the Heart is a Machine of Motion, not as acted alone by fleshy Fibres (*qua pure & precise tales*) but as accompanied with Nervous and Tendinous Fibres, which are inserted into, and mixed with Carnous, and are great Auxiliaries, if not principal Actors in the repeated Systoles of the Heart; This may be clearly proved by a Ligature made upon the eighth Pair of Nerves in the Necks of Animals; whereupon the Heart will be highly

highly afflicted with great Palpitations, faint Pulsations, and difficult Breathing, caused by the current of Nervous Liquor (inspired with Animal Spirits) much intercepted in its progress toward the Heart by a strong compress of the eighth pair of Nerves.

The Nervous Liquor is enobled with Animal Spirits seated in the Brain, being a system of numerous Fibres, as in a Fountain, from which many constant streams of Animal juice are gently transmitted through several divariations of Nerves (relating to the eighth pair and Intercostal Nerves) into the fleshy Fibres and Tendons of the Heart, which are rendered Tense with their Nervous Liquor, expanded and invigorated with the Subtle and Elastic Particles of Animal Spirits, as well as the Carnous Fibres are swelled with innumerable drops of Vital Liquor, received through many Pores into their spongy substance, whereby the many Lairs of fleshy Fibres, fastned to each other by strong Ligaments, and the mutual union of fleshy Fibres (interceding them) do more and more Contract toward the Center, and cause the Walls of the Ventricles to make brisk Appulses upon the Blood, and by a violent Compression force it out of the Cisterns of the Heart into the adjoining Sanguiducts.

The Carnous Fibres are acted by Nervous, as enobled with Animal Liquor and Spirits, whence they are rendered tense.

CHAP.

CHAP. XIX.

Of the Pathology of the Motion of the Heart.

HAVING given a History of the Motion of the Heart, Mechanically performed by the Contraction of various ranks of fleshy Fibres, associated with many Tendinous and Nervous Fibres; My design at this time is to speak of the Pathology of its Motion, as it is after a manner abolished, diminished, or depraved.

The Syncope and Lipothymy of the Heart, do differ gradually.

The two first irregular Motions of the Heart may be comprised in a Syncope, and Lipothymy, which do not formally or essentially differ, but only gradually, *secundum Magis & Minus*, as the first is higher than the latter; So that they being both symptoms attending the Motion of the Heart are near akin to each other as proceeding from the same causes, as affected with higher or lower degrees, *vid.* From the defect of Blood, or too great a quantity, or from its grossness or Concretion, or from Corruption, or lastly, by the defect or fault of the Animal Spirits.

The first cause of defect of Blood.

The defect of Blood in the Heart, may proceed from a weak concoctive faculty of the Stomach, derived from a want of due Ferments and kindly heat in Chronick and acute diseases; whereupon a small quantity of Chyle (the *Materia substrata Sanguinis*) is produced.

The second cause of the Penury of Blood.

Another cause of the defect of Blood in the Heart, may be deduced from an obstruction of the ascendent Trunk of the *Vena Cava*, caused by some Fleishy substance, or by some concreted Blood intercepting the current of Blood into the right Cistern of the Heart, or by the same causes in the Pulmonary Vessels, giving a check to the motion of Blood out of the Lungs into the left Ventricle.

AN Instance may be given of the hindred circulation of Blood, produced from its Coagulation in the Trunk of the *Vena Cava*, in a Maid of Fourteen years old, who after she had been highly afflicted for a day with a great heaviness, and a vertiginous indisposition and frequent Syncopes, took her farewell of her Friends and her miserable life; and afterward she being opened to inspect the cause of her death, the Brain was found to be free from any disaffection, and the *Vena Cava* to be filled with concreted Blood, which rendred the right Ventricle empty of it, which proved fatal to this young Virgin.

A second cause of a Lipothymy.

Another cause of a Lipothymy or Syncope (often attended with a fatal stroke) may arise out of so great a torrent of Blood, carried into the Ventricles, that the Heart is not able to discharge it out of the right into the Pulmonary Artery, nor out of the left into the *Aorta*; whereupon a suddain Suffo-

Suffocation the Heart immediately ensueth, and the motion of the Blood wholly taken away.

Sir Robert Fen, a worthy Gentleman, and Servant of King Charles the First, of most blessed Memory, being subject to great Passion, was so highly surprized with Fear, upon the occasion of a conceived imminent loss, that he fell down dead in a moment, which was (as I humbly conceive) caused by a great souch of Blood suddainly impelled into the right Ventricle, and Suffocated the Heart.

An instance of this cause.

A third cause of a Lipothymy or Syncope, may be deduced from a grossness or concretion of Blood, proceeding from an over-fibrous disposition, that is, from numerous Films and Vesicles containing gross Atoms of Blood full of fixed Saline Particles, Coagulating the Blood in the Ventricles, often producing a *Polypus*, inducing these ill accidents of the Heart.

A third cause of a Lipothymy.

These symptoms may also be caused by some fleshy Excrecence filling up either of the Ventricles; So that they are not receptive of Vital Liquor; whereupon the Heart loseth its use and motion, as being designed by Nature to transmit Blood into all parts of the Body.

These symptoms may proceed from an Excrecence filling up either Ventricle of the Heart.

A Woman of great Honour and Birth, was frequently tortured with a pain of the Heart, and great Fainting Fits, which could not be taken away by the power of Art, and at last the pain and Lipothymies growing more and more afflictive, Death became the best remedy. And afterward her Body being opened, and her Heart inspected, a black Flesh substance somewhat resembling a Medlie in figure, was discovered in the left *Sinus* of the Heart.

Another cause of these ill symptoms of the Heart, may be taken from a Purulent Matter flowing from an Ulcer of the Heart, tainting and distoning the mass of Blood passing through the Ventricles; whereupon the Fibres of the Heart grow faint, and at last lose their Contractions proceeding from a vitiated dispirited corrupted Blood, received into their inward Compage, whence follow Lipothymies, Syncopes, and Death it self.

A Syncope and Lipothymy may come from Purulent Matter, or Ulcer of the Heart.

A Citizen long afflicted with a high Hypochondriacal passion, and an acute Fever, accompanied with Lipothymies and Syncopes, determining in a happy departure, as the period of pain and misery, his Body being Dissected, the Cavity of the *Thorax* was found full of a thin, red, fetide humor, which was also lodged in the left Ventricle of the Heart, flown from an Ulcer.

These severe accidents of the Heart do often arise out of the Ulcers of the neighbouring parts, as the Lungs, *Pleura*, *Mediaſtine*, *Midriff*, *Liver*, *Spleen*, *Pancreas*, which being oppressed by Ulcerous Matter, do transmit it by smaller branches of Veins peculiar to the said *Viscera*, into the ascendent Trunk of the *Cava*, and from thence into the right Ventricle of the Heart, whereby its Fibres are highly discomposed by Pus imbibed into them with the Blood.

These symptoms may arise out of Ulcers of the adjacent parts.

A Syncope
and Lipothymy
coming
from Malignant
steams of
the Blood in
Pestilential
Fever.

These most troublesome accidents of the Heart perverting the Oeconomy of its Motion, are often produced in Malignant Fevers, by Venenate Steams corrupting the native disposition, and distoning, and destroying the Spirituous parts of the Blood, whereupon it groweth Concreted in the great Vessels, and Ventricles of the Heart; So that the poysonous steams being received with the Blood into the substance of the fleshy Fibres, do weaken, if not take away their Contractions, whence ensue Lipothymies and Synopes, the forerunners of Death.

The symptoms
may come from
the indisposi-
tion of the
Brain.

Another cause of these dreadful Symptoms may be derived from the indisposition of the Brain, either not generating a sufficient quantity of Nervous Liquor to invigorate the Nerves of the Heart, or else if it be generated, cannot be transmitted to the Cardiac Nerves, caused by some obstruction of them, whereupon the Fibres are not able to play their parts in the scene of repeated Motions, as not impregnated with Animal Spirits, which may be one cause of Lipothymies and Synopes, speaking a conclusion to Life.

The Palpitation
of the
Heart.

And the motion of the Heart is not only lessened in Lipothymies, and abolished in Synopes, but depraved also in Palpitations, which are sometimes so great, that the Cone striketh the left side near the Pap with so great a violence, that it may be plainly seen, felt, and heard too at some distance.

The cause of
the Heart
striking the
left side.

The Mechanick cause of an erection of the Heart whereby it striketh the Breast, proceedeth very much from the oblique situation of the Heart and disposition of the Fibres, which are obliquely and spirally wreathed and brought round from the right toward the left side of the Heart, and this posture of the Fibres is very much assisted by the conformation of the Heart, as the left Wall is more short and less Carnous, and crooked, in the left Ventricle of the Heart than in the right, which is encompassed with two Walls, as Learned Borellus hath observed: *Unde (ait ille) in Systole erigi debet Cordis mucro versus sinistram partem pectoris, eamque percutere potest pro gradu violentiae, qua erigitur. Hoc salvari quoque potest, vel adjuvari ab erectione Cordis oblique jacentis, vel à situatione, & dispositione Fibrarum, quae oblique spiritaliter circumducuntur à parte dextra basis Cordis versus sinistram partem Verticis, unde in inflatione Fibrarum anterieus versus sinistram partem, & sic percussio fieri potest.*

The Palpitation
proceeding
from too
great a quan-
tity of Blood.

The erection of the Heart, perverting the Oeconomy of Nature (wherein the Mucro of the Heart maketh violent strokes upon the left side) is called Palpitation, which may be derived from many Causes, one may arise from too great a quantity of Blood, which the Heart being unable wholly to discharge in every Systole, is so oppressed, as to make strong and frequent Contractions of its Fibres, (wherein the Cone of the Heart being elevated, maketh strong Appulses upon the left side) to discharge the exuberant Blood by most brisk Vibrations.

A second cause of the Palpitation of the Heart, may be fetched from an undue fermentation of the Blood, as consisting of unactive, and too much depressed Elements, hindring the Intestine motion of the Vital Juyce, which is often found in Cachectick bodies in the Scorbutick Distempers of Men and Women, wherein the dispirited mass of Blood is apt to Coagulate in the Ventricles of the Heart; So that the Heart is forced to make many brisk and often repeated Systoles, and erections of the Cone against the left side.

The second cause of the Palpitation may be taken from an undue fermentation of the Blood.

A third cause of this Disaffection may take its rise from the great effervescence of the Blood, proceeding from a high Fermentation of it, as composed of too much exalted saline and sulphureous Particles often found in Hypochondriacal and Hysterical Distempers. Wherein the Fibres of the Heart, being highly aggrieved with the fiery heat of overmuch fermenting Blood, do produce vigorous Constrictions of the Ventricles, and strong Vibrations of the Cardiack Cone against the Thorax.

A Palpitation of the Heart arising out of an effervescence of the Blood.

The fourth cause of this disorderly Convulsive motion of the Heart, may be derived from the indisposition of the Cortex of the Brain, in which an ill Animal Liquor is generated, as partly consisting of exalted Saline and Oily Particles, produced from ill Blood, whose Albuminous part is the *Materia Substrata* of Nervous Juyce, which is transmitted through the Fibrous parts of the several processes of the Brain, into the Origins of the eighth pair of Nerves, and from thence into the Cardiack branches, whereupon numerous Nervous Fibrils (inserted into the Carnous Fibres) being highly irritated by an ill *Succus Nervosus*, do draw the Fibres into violent irregular Convulsive motion; So that the elevated Cone of the Heart maketh many impetuous strokes against the Thorax.

The Palpitation of the Heart proceeding from the indisposition of the Brain.

As to the Cure of the Palpitation of the Heart arising from too great a quantity of Blood clogging the Heart, and putting the Fibres upon irregular Contractions; it denoteth a free mission of Blood which will speak an Alleviation to great Vibrations of the Heart.

Blood-letting is good, in a Palpitation of the Heart flowing from an exuberance of Blood.

An instance may be given of this disaffection in a Knight, a Pensioner of his Majesties, who being endued with a Plethorick constitution, was often afflicted with a great Palpitation proceeding from an exuberant quantity of Blood (evidenced in a high Pulse) oppressing the Heart, and was immediately freed from this troublesome Distemper, in opening a Vein, by which a large proportion of Blood was immediately discharged, and the Patient relieved.

The

Bitter Medicines are proper in a Palpitation of the Heart.

The irregular motions of the Heart (derived from the want of Fermentation of Blood, produced by improper Ferments) do indicate bitter Medicines, which Corroborate the Stomach, and Anti-Scorbutick Medicines mixed with Chalybeates, which rectifie the fixed saline and sulphureous parts of the Blood, and endue it with proper Fermentative Principles.

A Mercers Wife in *Covent-Garden*, endued with a thin Body, a weak Pulse, and an ill Concoction of Stomach, was often highly afflicted with Palpitations of the Heart, proceeding from the defect of a good Intestine motion of the Blood, whereupon it grew depauperated, and the Patient liable to fainting Fits, and a great difficulty of Breathing, which were much alleviated by bitter Decoctions, Pearl Julaps, Spirit of Hartshorn, and Chalybeates given in Apozemes made of opening Roots, *Sarsa Parilla*, Pine and Fir, and at last by the drinking *Tunbridge Waters*.

Testaceous Powders are good in an undue fermentation of the Blood.

The Palpitation of the Heart arising out of the Blood (over acted with too high an Intestine motion of the Blood, produced by exalted saline, and sulphureous parts) doth denote Testaceous Powders, as Pearl, Crabs Claws, Crabs Eyes, Coral, and the like, which do dulcifie the mass of Blood, given with temperate Diuretick Apozemes, and discharge the fixed saline Particles by Urine, and attemper the hot Atoms of Blood: In this case also Chalybeates mixed with temperate Anti-Scorbuticks, may be given with good success.

An instance of the Cure of the Palpitation of the Heart derived from an ill fermenting Blood.

Dr. *Huit*, a Person of great Vertue, Learning, and most eminent Loyalty (for which he was Murdered in the time of Usurpation) was affected with a hot Scorbutick habit of Body, and highly discomposed with great Palpitations of the Heart, taking its rise (as I humbly conceive) from too great a Fermentation of the Blood, as consisting of active Heterogeneous Elements, whereupon I advised him to take Testaceous Powders, taken with cooling Julaps, and temperate Cordials, mingled with Pearl, as also Chalybeate Syrups, taken with Diureticks and temperate Anti-Scorbutick Apozemes, by which the Patient (God be praised) was perfectly recovered.

Cephalick Medicines are proper in the Convulsive motions of the Heart.

The fourth kind of irregular motion of the Heart being Convulsive, (as produced by an ill *Succus Nervosus*, transmitted into and irritating the Cardiack Nerves) doth denote proper Medicines to refine the Albuminous part of the Blood, the *Materia Substrata* of Animal Liquor, and also Cephalick Medicines to Corroborate the Brain, and Nerves of the Heart.

Palpitation

Palpitations of the Heart are accompanied also with Convulsive motions of the Nerves seated in divers parts of the Body, and chiefly about the Base of the Heart (which is backed by the Sentiments of Learned Dr. Willis) encircling the Trunks of the *Aorta*, and *Vena Cava* to hinder the immediate flux and reflux of the Blood, and its great effervescence and Stagnations, produced by vehement passions of Anger, Fear, Sorrow, and Joy, which highly disorder the various Nerves inserted into the Coats and make irregular motions in the Arteries, and especially in the *Aorta* near the Heart, whereby its Nerves are drawn into Consent, and are productive of Convulsive Motions.

A second cause of the Convulsive motions of the Heart.

Another cause of the unkindly motion of the Heart may proceed from the frequent Pulsation of the Arteries, caused by the Carnous Fibres, irritated by the Convulsive motion of the great company of Nervous Fibrils, implanted into the fleshy Fibres of the Trunks relating to the Arteries, which renders their repeated Contractions very violent, whereupon the Blood is impetuously moved first through the Arteries, and then through the smaller and greater branches of the Vein into the right Ventricle of the Heart; So that the Carnous Fibres are highly sollicitated to make many irregular Motions, which are in truth Convulsive in order to discharge the great torrent of Blood into the Pulmonary Artery, which being highly aggrieved by impetuous streams of Purple Liquor, doth make irregular Contractions (to discharge the exuberant source of Blood into the Pulmonary Vein) which draweth the Heart into a Sympathy, as the Orifice of the Pulmonary Artery is implanted into the right Ventricle of the Heart.

A third cause of Cardiac Convulsions.

A fourth cause of the inordinate motion of the Heart may be deduced from the Nerves, animating the Carnous Fibres of the Arteries which do interrupt the equal and natural course of the Blood, by reason the Cavities of the Arteries are very much narrowed by the Convulsion of the Nerves inserted into the Carnous Fibres; whereupon the impulse of Blood is stopped, as in the disorder of the Nerves in great passions of Anger, Fear, Sorrow, and the like, which cause great consternation and confusion: So that it is probable that the Trunk of the *Aorta* being very much lessened by the Convulsion of the Nervous Fibril drawing the Carnous (seated in the Coat of the great Artery adjoyning to the left Chamber of the Heart) much hinder the motion of the Blood out of the Heart into the *Aorta*; whereupon the Ventricle of the Heart being highly distended by overmuch Blood, will cause many violent Pulsations or Convulsive Contractions, to discharge the exuberant quantity of Blood into the Orifice of the great Artery.

A fourth cause of Convulsive motions in the Heart.

Persons subject to immoderate passion of Anger, Grief, Joy, and those that are much afflicted with Hypochondiacal, and Scorbutical Diseases, are very obnoxious upon every light occasion, and sometimes without any provocation to passions and convulsive motions of the Heart, called vulgarly the Palpitations of it, as having the Cardiac Nerves affected with a gross *Succus Nutricius*, proceeding from ill humors in a Cachectick body oppressed with Acide Ferments of the Blood, acted also with gross saline Particles. Palpitations of the Heart also proceed from a great quantity of Blood, ready to suffocate the Heart, and put the Fibres of the Heart into inordi-

nate Motions, as well as the Nerves highly irritated by an exuberance of Blood, compressing of the Heart, and thereby hindring the passage of the Nervous Liquor in the Interstices of the Filaments often productive of Convulsive motions afflicting the Heart; These irregular motions are also generated in the origen of the Nerves, when they are disordered with some Acrimonious Matter vellicating the Fibres seated in the ambient parts of the Brain.

As to the Cure of these Convulsive Motions producing a great exuberance of Stagnant Vital Liquor in the Heart, it denoteth frequent opening of a Vein, to sollicite the motion of Stagnant Blood to abase its quantity.

And in reference to the cause of Convulsions (seated in the Nerves) producing the palpitation of the Heart, Cephalick Apozemes, Electuaries, Spirit of Hearts Horn, Spirit of Amber Succinated, &c. may be of great use.

CHAP.

C H A P. XX.

Of the Motion of the Blood.

HAVING given my Sentiments of the Structure and Motion of the Heart, I will now Treat of the Motion of the Blood, as the End and Complement of the other; by reason the Heart is designed by Nature, to be a rare Engine of Motion, to make good the circulation of the Vital Liquor.

The All Wise and Omnipotent Agent created Man as the Sovereign of this lower Orb, after his own Image, and inspired him with the Spirit of life, conserved by Motion of the Blood; and to this end the Grand Architect hath framed a fit Apparatus of Organs; the Heart as a noble Blood-work, furnished with numerous appendages of Channels, as so many Sanguiducts, the Veins and Arteries to import and export streams of Blood to, and from the Heart, as a choice Engine to promote the Motion of the Blood, the great preservative of Life.

In order to the better understanding of the Motion of the Blood, these Considerables may seem to offer themselves to our notice; First, The manner how this Motion is accomplished: Secondly, What quantity of Blood passeth through the chambers of the Heart in a short space of time. Thirdly, The Cisterns and Ducts through which this noble Liquor floweth out of the Heart, first into the Lungs, and after runs into all parts of the Body: And Lastly, the end to which the Motion of the Blood is consigned.

The Motion of the vital Liquor is performed by the Diastole and Systole of the Heart; the First is rather a Laxament than a Motion wherein its Fibres are relaxed by streams of Blood (expanding the cavities of the Heart) which being received through numerous Pores, into the inward Compage of the fleshy fibres, do enlarge their Dimensions, and put them upon greater and greater Contractions, as they more and more approach the center, whereby the Concave surface of the Ventricles grow less and less, as they approach nearer and nearer to each other.

In the Diastole of the distended fibres, the Ventricles are dilated with a quantity of Blood, filling up their Cavities, and in the Systole, their concave Perimeter is taken up with fleshy fibres, having imbibed innumerable drops of Blood; whereupon the inward swelled walls of the Heart being drawn close to each other, do squeeze the drops contained in the pores of the Fibres, and the greater streams of Blood (lately received into the empty spaces of the Ventricles) into the neighbouring Arteries, to make good the Motion of the Blood.

As to the manner how the motion of the vital Juyce is managed out of the Cistern of the Heart, into the adjacent Sanguiducts; some conceive it to be acted mechanically, by a spiral wreathing of the Fibres, after the same manner as water is squeezed out of wet Cloaths, by a greater and greater winding them round, whereby the drops of liquor lodged in the many interstices of the Filaments, do quit their Allodgments; but it may be proved by Reason and ocular Demonstration, that there can be no such straining the Blood by the constriction of the Ventricles of the Heart, by the same Organs,

and

The manner
of the motion
of the vital
Liquor.

The Ventri-
cles of the
Heart are di-
stended with
Blood in the
Diastole, and
emptied by a
Systole.

The manner
how the Moti-
on of the
Blood is made
in the Blood-
Vessels.

and the same mechanical action; by reason the filaments of the Cloth were laxe before their Contorsion, as having many interstices, obtaining a repletion by many drops of Water; but afterward when the Cloth was variously modelled into divers wreaths, the filaments were forced to make many Circumvolutions about the body of the Cloth; whereupon the threads were not only lengthened into oblong Gyres, but were also lessened in bulk, and rendred more tense; but the repletion of the Cavities of the Heart with Blood, was made in a different manner from that of the Interstices of the Filaments of the Cloth filled with Water, in which the Threads require greater Dimensions in length; but the Fibres of the Heart are rather contracted, according to the nature of all Muscular Fibres, and the Cavities of the Heart grow greater in breadth, as being expanded by the repletion of Blood; and above all the Pores of the Fibres, and Cavities of the Ventricles, are not emptied by any Contortion, as it is made inward in the Filaments of Cloth, when the Water is squeezed out of their Interstices; but the Blood is strained out of the Pores of the Fibres, and Ventricles of the Heart, not by various wreaths, but by many corrugations of the Fibres more and more contracting, as they come nearer and nearer to the Center of the Ventricles, whereby their Walls are brought close, and briskly dash against each other, produced by the strong Contractions of many ranks of Fibres tied together by firm Ligaments, and a mutual intercourse; so that the sides of the Cisterns of the Heart, by joynt appulses being dashed against each other, do squeeze out the Blood not by Contorsion of the Fibres, (as when the Water is wrung out of the Interstices of a wet Cloth by the force of many Circumvolutions) but by the mutual Contacts of many ranks of contracted Fibres, running close to each other, whereby the Concave Perimeter of the Ventricles is taken away, and the Blood squeezed (after the manner of a Presse) into the adjoining Blood-Vessels.

Borellus Opinion, that the Constrictive Power of the Heart is less then the resistance of the Blood.

Learned *Borellus* is of an Opinion, that the constrictive power of the Heart is less then the resistance which the Blood maketh in the Ventricles of the Heart, as this renowned Author hath it, *Tomo 2^{do}. De motu animalium Propos. 70. P. 139. Potentia Cordis Musculum constringens minor est resistentia, quam exercet sanguis in ventriculis ejus Contentus in proportione subsesquiatera*; which if true, (as I humbly conceive) the Blood would be stagnant in the Ventricles, as over-balancing the power of the Fibres, by the resistance of its Elastick Particles, countermanding the Appulses of the Fibres, upon the Blood, in order to its Compression and Exclusion, which contradicteth Experience and Autopsy, because the Fibres of the Heart do more and more contract as they come nearer to the Center of the Heart, till the Concave Surface is reduced toward a Plain, whereby the constrictive power of the Fibres do so highly compress the Blood, that they wholly overpower the resistance it maketh in the Ventricles, by impelling it into the neighbouring Sanguiducts.

The reason of the Authors said Opinion

The External Fibres of the Heart, (as the said Learned Author apprehendeth,) do act after the manner of a Rope, encircling a Globe or Cylinder; so that the power contracting the External Fibres of the Heart, hath the same proportion in reference to the resistance of the compressed Blood, as a Semidiameter to the circumference; that is, saith he, in the recited Page, that the power of the Fibres is less by a Sixth part then the resistance of the compressed Blood. *Præterea, ait ille At Fibrae Cordis profundiores, & Externarum partes cavæ agunt rugas & plicas inflando & adeo actione Cunei, vel Emboli*

boli impellunt directo motu a peripheria ad Cordis centrum Sanguineum ei inclusum.

Quia vero in hac actione equalibus momentis per eosdem diametros, eodemque tempore fit impulsus & repulsus, ergo potentia Fibrarum internarum equalis resistentiae Sanguinis ab eis Compressi. So that here this Great Author granteth a greater constrictive power to the Fibres of the Heart, then in the beginning or proposition of the Chapter, where he saith it is inferior to the resistance the Blood maketh in the Ventricles of the Heart, to which I have given my reply above, for which I humbly beg pardon in not complying with his Learned Sense, which I submit to the most Candid and Judicious Reader.

The manner of the Motion of the Blood having been discoursed, now followeth in order the Quantity of Blood that passeth through the Heart every pulsation, which some Anatomists have made very inconsiderable, as being a Scruple, Drachme, or half an Ounce; And I humbly conceive that the Heart of greater Animals as endued with more large Cavities, are receptive of a greater proportion of Blood, of which the chief part, if not all, is discharged in every Systole.

In every Diastole the Cisterns of the Heart are filled with Blood, and are emptied every Systole into the adjoining Sanguiducts, by reason the Walls of the Ventricles are so closely conjoynd by the strong contractions of the Fibres, that the Blood must be wholly squeezed out of the greater Cavities of the Heart, into the smaller Cylindres of Arteries in every Pulsation.

This assertion may be made good in the Dissection of live Animals, wherein the Cone of the Heart being cut off, and a Finger immittied into the Left Ventricle, it will be found to be highly pinched by the strong Contraction of Flethy Fibres, narrowing the Cavity of the Ventricle; whence it may be clearly inferred by the same reason, that the Blood contained in the bosom of the Heart, must be discharged by a powerful Compression in every Systole.

This Hypothesis may be farther proved by ocular Demonstration upon the opening the Bodies of Frogs, Eels, Vipers, Snakes, &c. wherein it may be plainly discerned that their transparent Hearts turn pale every Systole, as having their Ventricles empty of Blood, and their hearts grow Red again in the Diastole, as filled with streams of Purple Liquor, tinging them with a more vivid colour.

And by Analogy of Reason, the Cavities of the Hearts of greater Animals are filled with Blood in every Diastole, and emptied in the Systole, though it cannot be discerned by reason of the thick and opaque fleshy Walls, within which the chambers of the Heart are enclosed.

These Premises being granted, it will not be difficult to compute what quantity of Blood passeth through the Cysterns of the Heart into the Sanguiducts, in the space of an hour; and upon a supposition that Two Ounces of Blood, as transmitted out of the Left Ventricle in every Pulsation (as Great Dr. Harvey, and Renowned Dr. Lower have observed) and that all the Blood received every Diastole into the Cisterns of the Heart, is discharged by every Systole into the adjacent Sanguiducts, and that in the space of an hour, Two thousand Pulses being counted; it will follow of necessity, that Four thousand Ounces of Blood are carried through the bosom of the Heart in Threescore Minutes; So that the said quantity of Blood doth amount to Three hundred thirty and two pound; and it being supposed that a Man is furnished with Twenty five pound of Blood,

The proportion of Blood which passeth through the Heart every Pulsation.

The Ventricles of the Heart are filled every Diastole, and emptied every Systole.

An Experiment in the Dissection of live Animals.

The Motion of the Blood made good by Autopsy in live Animals.

The quantity of Blood received in every Diastole, is wholly discharged in every Systole of the Heart.

The whole
Mass of Blood
doth probably
pass Twelve
times through
the Heart
every hour.

(which is a liberal proportion) it may be inferred, that the whole Mass of Blood doth circulate through the Ventricles of the Heart above Twelve times in an hour, and oftner in Men that have quick Pulses, and small Masses of Blood, and in Persons sick of Fevers, and in Footmen (who run violently) whose Hearts are acted with frequent Pulsations; the streams of Blood, are carried more impetuously through the Caverns of the Heart, into the neighbouring Arterial Channels.

On the other side in *Chacochymick* Habits of Body, as in Hypochondriacal, Scorbutick Dispositions, and in divers Chronick Diseases, the Heart is affected with faint Pulsations, as often obstructed in some parts with gross faculent and dispirited Blood, and the Fibres being Languid, the Systole must be weak, rare, or unequal, and sometimes intermittent; so that a much less proportion of Blood passeth through the Heart in a sick, then in a vivid healthy Man, having quick, equal, and strong Pulsations.

It is difficult
to compute
what quantity
of Blood passeth
through
the Heart in
several Ages,
Sexes, Tem-
peraments.

And I most humbly conceive, that it is not possible to give a true estimate of the Motion of the Mass of Blood in several Ages, Sexes, Tempers, in what time it is certainly performed, only this may be maintained as a great Truth; that the current of Blood runneth more hastily through the Heart of healthy and strong Animals, whose hearts are furnished with large solid Fibres.

The vital streams run more quick in the greater Cylinders of Arteries, whose Trunks adjoyn to the Heart, then in the smaller Channels seated in the Ambient parts, at a great distance from the vital machine of Motion.

An argument
to prove the
quick Motion
of the Blood
through the
various Blood
Vessels.

If any curious Person shall desire a farther account of the quick passage of the Blood through the Heart, and various arterial and venal Tubes into all parts of the Body; it may be made clearly appear, by the association of Blood with the Saline watry Particles, which are carried by the Emulgent Arteries, in great quantities into the Renal Glands, wherein the serous Recrements are Secerned from the Vital Juice, and transmitted by the Urinary Ducts, *Pelvis* and *Ureters* into the Bladder; so that if free Draughts of Wine, or Ale, be received into the Stomach, they will be conveyed through the Mesenterick and Thoracick Milky Vessels, into the Subclavian Veins, where the potent Matter mingleth with the Blood, and is transmitted through the *Vena Cava*, Right Ventricle, Lungs, and Left Chamber into the common Trunk of the *Aorta*, and thence through the Descendent Trunk, and Emulgent Arteries, into the Kidneys; so that the potent Liquor is carried through several stages of various parts and Vessels, in a great proportion, and in a short time conveyed out of the Body; Whereupon the serous part being but a small portion, mixed with the Blood, and transmitted with it through many Sanguiducts in great quantity, in a very short space, doth render it most conspicuous, that the Blood hath a very hasty Current through the Heart and other parts of the Body.

The Motion
of the Blood
through the
Vessels
is very hasty.

And it may be farther evidenced by an Experiment, that the streams of Blood running through the Chambers of the Heart, and other Channels of the Body, are very quick, by opening the Carotide Artery in the Neck; Whereupon the greatest part of Vital Liquor will be let out in a very short space.

The Motion
of the Blood
is performed
in different
Channels of
Veins and
Arteries.

The Blood consisting of innumerable fluid minute Bodies, being in perpetual Motion, runneth after the manner of a River, in a constant Current out of the Cavity of the Heart, by various Sanguiducts, as so many Channels confining its streams (as within Banks) into all parts of the Body.

The

The Veins are the primary Ducts in which the Blood beginneth its Motion in the Womb, in the Ambient parts of the colligated Seminal Liquor, (enlivened by the heat of the *Uterus*) where the Blood receiveth its first Formation in a rough draught, and is afterward conveyed through a Vein (formed out of the united Filaments of the Seed) to the beating, point of the first Rudiment of the Heart, and is thence impelled through an Artery, as another kind of Sanguiduct arising near the Heart, (to which it is united) out of the Filamentous parts of the Seed, conjoynd in a round Concave Figure, after the manner of a Cylinder: And when the Viscera, and the other more Ambient parts of the *Fœtus*, by divers processes of Generation, do arrive to greater and greater Maturity; the Rivulets of Blood grow greater, and the Cysters of the Heart grow more ample, and the various venal, and Arterial Tubes, become more numerous and enlarged.

The Motion
of the Blood
beginneth in
the Veins.

The Origen of Venal Branches seated in the more remote parts from the Heart, in a formed Embrio, receive Blood, and import it out of the *Vena Cava* by a large *Foramen* (endued with an Oval Figure) into the *Arteria Venosa*, and from thence into the Left Ventricle of the Heart. And in a new born Infant, when respiration is celebrated, the current of Blood is diverted another way, and passeth out of the Orifice of the *Vena Cava*, into the Right Auricle and Ventricle; from whence it is transmitted through the pulmonary Artery, into the substance of the Lungs, and then received into the Origins of the pulmonary Veins, and afterward through the Left Chamber of the Heart, into the common and Ascendent and Descendent Trunk of the *Aorta*, and branches into the upper, middle, and lower Apartments; And afterward the Blood being discharged into the substance of all parts of the Body, is brought back again by innumerable branches of Veins (inserted into the Descendent and Ascendent Trunk of the *Vena Cava*, into the Right Cistern of the Heart.

The Blood
doth not pass
in an Embryo
through the
Lungs.

This rare Engine of Motion may truly deserve the Appellative of a noble and well contrived Blood-work, consisting of Cysters, and Ducts, in some sort resembling a Pump, furnished with appendant Pipes.

This Machine of Motion hath its Cysters filled with vital Liquor, which is received into the Pores of many ranks of Fibres, whereby they becoming swelled, do approach more and more toward the Center, and draw the Wall of the Ventricles close together, which dashing against each other (made by brisk Contractions of Fibres, irritated by a plenty of rarefied Blood) do by a strong Compression overpower the resistance of the Blood in the Ventricles, and of the incumbent Blood, contained in the Ascendent Trunk of the *Aorta*, and Carotide Arteries; Whereupon the Blood being forced, as by a Pump out of the Ventricles into the Sanguiducts, as out of Cysters into appendant Pipes, doth make a Current by pressing one part of the Blood after another, which is not solely performed and acted by the impulse proceeding from the Systole of the Left Ventricle, by reason the Arteries, as consisting of many Coats made up of divers Fibres, are endued with a pliable disposition, and subject to be dilated by Blood, injected into the Cavities of the Arteries, which is rather a cause of Retention, rather than Motion of the Blood, which ought to be made in a direct, and not a lateral progression, which giveth somewhat of check to the flowing of the vital streams.

Furthermore, by reason the Rivulets of Blood are impelled out of greater Trunks into smaller branches, and at last into most minute capillary Ramulets of Arteries, the divided streams do lose much of their impulse,

impulse imparted to them from the Systole of the Heart; and also because the extremity of the capillary Arteries are very narrow, and do not easily admit the expulsion of Blood into the substance of various parts, relating to the Body; Therefore Nature hath most wisely contrived some other Machines of Motion (seated in the Blood-Vessels) as Auxiliaries to the Fibres of the Heart, to assist the impulse of the Blood, derived from the Systole of the Heart.

Fleshy Fibres
are seated in
the Sanguin-
ducts.

It is most evident, that the Arteries being soft membranous Tubes, are apt to be expanded, as acquiring greater Dimensions in breadth, caused by the immission of some Ounces of Blood into their bosom (in every Systole of the Heart) which cannot be discharged by the innate motive power of the Blood: Therefore the All-Wise Protoplast hath made External Agents to give an impulse to the Blood, first communicated by the Fibres of the Heart, and afterward aided by little fine Organs of Motion (seated in the Coats of the Sanguin ducts) which are long and circular fleshy Fibres, contracting and narrowing the Cavities of the Arteries, by bringing their insides closer to each other; whereby the current of Blood is quickened by the Compression of the Vessels, by causing one part of the fluid Compage of Blood to press another forward, and so make good its Flux and Reflux, from and to the great Blood-work of the Heart, by various pipes of Arteries and Veins.

The Motion
of the Blood
first made
the Heart,
is assisted by
the Motion
of the Arte-
ries.
The manner
how the
Blood is im-
pelled
through the
Arteries,

I humbly conceive the contraction of the Blood-vessels, in order to promote the Flux and Reflux of Blood, is celebrated after this manner,

The Arteries being dilated by the transmission of Blood into their Cavities, their distended Coats made up of nervous and fleshy Fibres, are irritated, as having their tender Compage enlarged by a quantity of Blood, so that the fleshy Fibres finding themselves aggrieved, do contract and lessen the bore of the Arterial Cylinders, and by compression do hasten the current of Blood, by making one part of this fluid Body crowde another forward.

The Heart re-
sembleth a
Pump, in
throwing
Blood into
the adjacent
Sanguin ducts.

The Heart after the manner of a Pump, throweth out of the Left Cistern, a quantity of Blood, every pulsation, into the Cavity of the Arteries, whence they grow dilated, and thereupon the Motion of the Blood would be intercepted, or much retarded at least, did not the Heart and Arteries by a joynt constrictive power of their Fibres, countermand the resistance of the Blood, made in the expanded Arteries, especially in the ascendent Trunk of the *Aorta*, and Carotide Arteries, where the weight of the incumbent Blood maketh a high opposition to the impulse of the Blood, immitted every Systole, first into the common Trunk, and afterward into the ascendent Trunk of the great Artery; Whereupon it is very requisite that the Arteries should have their Coats furnished with circular Fibres, that by their Contractions they might assist the Constrictive power made in the Left Ventricle of the Heart, whereby a quantity of Blood is first thrown into the common Trunk, and afterward carried upward, and contrary to the inclination of the Blood, (as a heavy Body) by the contracted circular Fibres of the ascendent Trunk of the *Aorta*, and Carotide Arteries, into the membranes and substance of the Brain.

Furthermore it is very needful that the Blood transmitted into the common Trunk of the *Aorta*, by the power of the Heart, should be seconded with another new force, carrying the Blood through greater and less branches, and capillaries of the Arteries, (wherein the impulse of the Blood given by the Heart groweth Languid) through whose minute terminations,

the

the small and faint vital streams cannot pass through the Interstices of the Vessels, unless their passages, much compressed in the Muscles, and *Parenchyma* of the *Viscera*, be dilated by a new impulse of Blood, imparted to it by the contraction of the circular Fibres, relating to the Arteries.

And the narrowness of the bore of the capillary Arteries, and their Terminations, and the straitness of the passages between the Interstices of the Vessels, do make a great resistance to the impulse of Blood, opening the Passages and Pores of the solid part, which are not only small, but have divers Figures like a Sieve, through which every particle of Blood insinuating it self, receiveth a like Configuration, as *Homogeneous*, *ut simile a simili nutriatur*; so that the Pores being prepossessed by the impelled nutritious parts of the Blood, do exclude the Excrementitious Atomes, from being admitted into the Pores of the solid parts.

And farthermore, the impulse of the Blood coming originally from the Systole, is promoted by the contracted circular Fibres, seated all along in the Coats of the Arteries, that the Motion of the Blood may be continued through the small capillary Arteries, and their terminations inserted into the cutaneous Glands, wherein a secretion is made of the Recrements (from the pure parts) which are carried off through the Excretory Ducts of the Skin by Sweat, and insensible transpiration.

And I most humbly conceive, that there is not only a constrictive Power seated in the Arteries, but in Veins too, which are accommodated with circular Fibres (plainly discernable in the Trunk of the *Vena Cava*) by whose Contractions the Blood received into the extremities of the Veins (of the lower Limbs and Muscles, and *Viscera* of the lowest Apartment) and afterward transmitted by their greater and greater Branches, and the Trunk of the *Vena Cava*, into the Right Ventricle of the Heart; so that the new current of Blood passing out of the Terminations of the Arteries, First, into the Interstices of the Vessels, and afterwards received into the Veins, could not over-power the resistance of the weight of the incumbent Blood, (seated in the ascending Veins) by virtue of a former Impulse given to the Blood by the Systole of the Heart, and Arteries, unless it were acted with a new impulse, made by the constrictive power of the circular Fibres, forcing the Blood upward (contrary to its innate disposition to move downward, as a weighty Body) through the Veins of the lower Limbs, and Muscles, and *Viscera* of the lowest Venter, and through the ascendent Trunk of the *Cava*, into the larger Cistern of the Right Ventricle of the Heart.

Perhaps some may object against this Hypothesis, by reason the Valves are seated in the inside of the Veins, to aid the progress of the Blood, tending to the Heart, lest it should make a retrograde Motion toward the Origins of the Veins. To which I take the freedom to make this Reply, that the Valves are not sufficient to make good the Ascent of the Blood, through the ascending Branches and Trunk of the *Cava*, and through the Branches of the Jugulars, and descendent Trunk of the *Cava*, when the impulse of the Blood, caused by the Systole of the Heart, and Arteries, groweth faint in the Termination of the Carotide Arteries, and Interstices of the Vessels of the Membranes, and substance of the Brain; so that when the Blood is received into the Veins at a great distance from the Heart, it is necessary that the slow Motion of the Blood toward the Heart, should be heightened by the Contractions of the circular Fibres, encompassing the Veins, seeing the Valves of the Veins do only hinder the

The Motion of the Blood would grow faint in Arteries distant from the Heart, were it not helped by the constrictive power of the Arteries.

The Veins have a constrictive power as well as the Arteries.

The Motion of the Blood upward, toward, and into the Head, is assisted by the constrictive power of the Veins.

The Valves of the Veins are not sufficient to make good the Ascent of the Blood toward the Heart.

Motion of the Blood toward the extremities of the Veins, and are not able to promote it all along their less and greater Cavities, ending in the Right Ventricle of the Heart.

In fine, I cannot but admire and adore the infinite Wisdom of the Omnipotent Agent, who hath mechanically contrived the Motion of the Blood, by the great *Apparatus* of Organs, in giving a constrictive power to the great Blood-work of the Heart, and in several appendant Tubes of Arteries and Veins, acted by various fleshy Fibres, as so many Machines, lessening the greater and smaller Cavities of the Heart, and different Sanguiducts, whereby the resistance of the Blood is countermanded by a strong Compression, and its Flux and Reflux are maintained to and from the Heart, to impart Life, Heat and Nourishment to all parts of the Body.

The Motion of the Blood, being a great instrument of the preservation of Humane Nature is consigned to many ends. The production of Blood, the generation of nervous Liquor and animal Spirits; the depuration of the Blood in various parts of the Body, and the formation of seminal Liquor in the Testicles.

The main end
of the Motion
of Blood,
is Sanguifica-
tion.
The manner
of production
of Blood.

The First and main end of the Motion of the Blood, is Sanguification, which is produced by Chyle assimilated into Blood, as more and more mixed with it in the Heart, Lungs, Arteries, and Veins.

The manner how the Blood may be produced, is this; The Chyle being associated with *Lympha* in the common Receptacle, is carried through the Thoracick Ducts into the subclavian Veins, where it confederates with the Blood, and is transmitted with it through the *Cava* into the Right Auricle, and Ventricle of the Heart, wherein it is dashed impetuously against its Walls, by the strong Contractions of fleshy Fibres, highly compressing the Chyle (confused with the Blood) and breaking it into small Particles; and then the Chyle somewhat mingled with the Blood, is carried through the greater Trunk, and smaller and smaller Branches, and capillary Arteries, where the Chyle receiveth a greater Comminution, which is made by a great Compression, by reason in inspiration, free draughts of Air are received into the Bronchia and Appendant Vesicles, whereby they being much, dilated do Compress the Sanguiducts, and break the Chyle (confederated with the Blood) into smaller Particles; then in the Right Chamber of the Heart, and in expiration, the Diaphragme being brought from a Plain to an Arch, and the Ribs from Right to more obtuse Angles, do press down the Lungs, whereby the cavities of the greater and smaller pulmonary Vessels are narrowed, and the Chyle being in conjunction with the Blood, is squeezed into small Particles, as protruded first through the small Terminations of the capillary Arteries, and straight Interstices of the Vessels, and through the more minute Origens of the pulmonary capillary Veins, Branches, and greater Trunk, into the Left Auricle and Ventricle of the Heart; wherein the Chyle being more embodied with the Blood, is farther beaten, as by a Pestle into many minute Atomes, against the sides of the Left Ventricle of the Heart; and from thence the Chyle mingled with the Blood, is carried through the numerous Divarications and minute extremities of Arteries and Veins, wherein by their innumerable circular Fibres, the Chyle receiveth greater and greater comminution, till it is perfectly assimilated into Blood; as making many circuits in an hour through the Heart, Lungs, Arteries, Veins, in which the Chyle in its progress with the Blood, is more and more exalted by the elastick Atomes of Air in the Lungs, and

with

with spirituous and volatil saline Particles in its Converse with the vital Liquor, till the Chyme receiveth its ultimate Disposition and Form.

The Second end of the Motion of the Blood, is in order to the generation of nervous Liquor, and animal Spirits in the Cortex of the Brain.

The second end of the Motion of the Blood.

The nobler part of the vital Liquor is impelled out of the common Trunk of the *Aorta* into its ascendent Trunk, and from thence carried through the internal, greater and less Carotide Arteries, passing through the Membranes, and inserted into the Cortical Glands of the Brain, wherein the more delicate, the albuminous part of the Blood is separated from the Red crassament, and turned into animal Liquor, inspired with exalted Spirits, as its more choice and refined Particles.

The Third end of the Motion of the Blood is its refinement from its Recrements, in its passage through the Interstices of the Vessels or Glands, lodged in the Muscles, *Viscera*, and *Cutis*.

The Third end of the Motion of the Blood.

The mass of Blood consisteth of two Essential parts, the Red Crassament, and albuminous Juyce, associated with Lymphatick, Bilious, and potent Liquor, which are secreted from it by its motion through many different Glands, as so many Colatories, seated in different parts of the Body.

The constituent parts of Blood.

The Blood being impelled by many branches of Arteries, into the substance of the Lungs, and the minute Glands of the Muscles, Spleen, Liver, wherein the Blood and Motion hath its Lympha, secreted from its nobler Liquor, and conveyed into the Lymphæducts of the parts (seated below the Diaphragma) into the common Receptacle, and into the Lymphæducts of those above, into the subclavian Veins.

The vital Liquor is transmitted out of the Left Ventricles of the Heart through the common, and descendent Trunk of the *Aorta*, and thence through the *Cæliack* Artery into the Stomack, and Spleen, and through the upper and lower Mesenterick Arteries into the Intestines; afterward the Blood is re-conveyed from the Stomack, Spleen, and Guts, by several branches of the *Porta*, and common Trunk, into the substance of the Glands of the Liver, wherein the more thin bilious Particles of the Blood, passing through the Interstices of the Vessels, is received into the Origins of the excretory Ducts and Trunk, relating to the *Vesicula fellea*, into its more enlarged Cavity. And the more gross parts of Bile, are severed from the Blood in the empty spaces of the hepatick Glands, and entertained into the excretory Vessels, leading to the *Porus Biliaris*, and from thence by a Trunk into the termination of the *Duodenum*, or beginning of the *Jejunum*.

The bilious Recrements of the Blood, are severed from it in the Liver.

Another serous and saline watry Excrement, is thrown off from the Blood in the Kidneys, in whose Glands the vital Liquor is depurated by Motion, as being carried out of the descendent Trunk of the *Aorta*, into the emulgent Arteries (inserted into the Kidneys) through whose terminations, the Blood passing into the empty spaces of the Vessels, is severed from its potent Recrements, which are transmitted through the Urinary Ducts, into the *Pelvis*.

The watry parts of the Blood, are secreted from it in the Kidneys.

And Lastly, the Blood is defæcated from its serous Recrements, by its motion from the Center to the circumference from the Heart, and greater Trunks of Arteries, into smaller and smaller branches, till the Blood be transmitted by the Capillars, into the ambient parts of the Body, into the substance of the cutaneous Glands, wherein the watry fæculencies and streams of the Blood are severed from the more refined Particles, and received into the excretory Ducts of the Skin, and thrown off by Sweat and Transpiration.

The watry Recrements are also separated from the Blood in the cutaneous Glands.

C H A P. XXI.

Of the Blood.

HAVING given a History of the Motion of Blood; I will now with your permission, speak of its constituent parts and Elements, as the Principles of Life, and of its various Disaffections, being the causes of different Fevers, as to many eminent Diseases of the Heart.

The Blood is a noble, if not the most excellent Liquor of the whole Body, as all humours are preparatory to it, or part of its Liquor, or Recrements blended with it, or separated from it; In this Liquor the early Rays of Life, the first operations of the Soul are displayed: so that the Blood is a part of as great Dignity as use, and well worthy of a curious search, and sober consideration, as preliminary to our farther discourse of the Brain, by reason the albuminous part of the Blood is preparatory to the nervous Liquor, as being its *Materia Substrata*, and is separated from the Purple Juice in the Cortical Glands of the Brain.

The constitution of the Blood is natural, or pre-natural.

The Blood, the Theme of our present Discourse, may admit a double Notion, as considered in its natural, or disaffected Constitution; as relating to its Salutary, it may not be improper to pry into its Nature and Properties, which may in some sort be comprized within three Heads, First of the Origin and Channels of it. Secondly, Of the constituent and integral parts. Thirdly, Of its Motion and Uses, to which it is consigned.

The first rise of the Blood

This generous Liquor, the first Particle of the *Fetus*, seemeth to take its first rise from the seminal Matter, the true radical moisture, whose purer and refined part, the vital Liquor is Colliquated by the Ambient heat of the *Uterus*, which every way encircling it, renders it more and more spirituous, in which the more subtle are severed from the grosser Particles; First, in the circumference (where the first glimmerings of Life appear) as being contiguous, and bordering upon the inside of the Womb, whose glowing heat maketh the first impression of Life upon the Ambient colliquated parts of the Seed, and then enters into its more viscid Compag, making its way from the circumference to the Center, in streams, bounded on every side with the clammy parts of the seminal Liquor, which by the heat of the Blood grow more and more consolidated, and receive the Models of membranous Tubes; the first rudiments of Veins conveying the Blood from the Chorion and Margent of the Seminal Liquor, to its more inward recesses, wherein the *Punctum Saliens* is lodged, by whose contraction the Blood passeth from the center of the genital Matter, toward the circumference, which maketh its retrograde Motion through the viscid part of the Seed, indurated into membranous Pipes, the first lineaments of Arteries, that export Blood from the beating point, to the skirts of the genital Liquor.

Having given you a short Narrative of the first production of Blood, and the formation of its Channels, the Veins and Arteries: The constituent and integral parts in order offer themselves to our consideration; The constituent parts are divided into the Crystalline and Purple Liquor, and the Chyme is no part but the *Materia substrata*, preparatory to the Blood, and its potent, or ferous parts are a Vehicle, which being impregnated by Sa-

line

line and sulphureous Particles, the recrements of the Blood are carried to the Kidneys, and by the secretion of the Glands, the serous Faculencies are discharged by the excretory Ducts, into the *Pelvis* and *Ureters*. But the Crystalline or Albuminous Liquor is of another Nature, as being the soft and mild part of the Blood; and though it is a thin transparent Liquor, yet it will not evaporate like the potulent Matter, but resembleth the Albuminous Liquor of an Egg, which being exposed to the Fire in a Spoon, will become concreted into a whitish Matter, not unlike the coagulated White of an Egg.

The Albuminous Liquor of the Blood.

But the Purple Liquor, or Red Crassament of the Blood, is an opaque visciduous Juice, which being let out of the Body, and left quiet, soon coagulateth into a gross solid Matter, whose surface is sometimes hued, with a florid Red in laudable Blood, proceeding from the Air.

The red Crassament of the Blood.

Sometimes the ambient part of the Blood is coated with a Whitish colour, which I conceive is derived from exuberant Chyme, newly associated with it, without any great alteration; at other times the upper region of the Blood is partly-coloured, in some part of a darkish White, in others of a muddy colour, interspersed with Greenish and Yellowish Particles, which floweth from an ill Chyle, as not well concocted in the Stomach; so that when it is transmitted by the lacteal Vessels into the Blood, it cannot be so matured, as to be assimilated, but receiveth some alteration in its circuit with the Blood, from its saline and sulphureous Recrements, which give that variety of Colours to the crude Chyme, swimming like an Efflorescence on the top of the Blood, appearing in a tough viscid Skin, which speaketh the crudity of the Chyle (not capable to be well attenuated by the heat and motion of the Blood) so that Nature endeavoureth often to free her self from this indigested Liquor, by making a secretion of it from the Blood in the Glands of the Kidneys, where it mixeth with the serous Matter, and is transmitted by the *Ureters* to the Bladder, where it maketh the gross white Contexts falling to the bottom of the Urinal.

The tough crust of the Blood.

The cause of variety of colours, painting the surface of concreted Blood.

Under the surface of extravasated Blood (which is affected with variety of Colours, partly Florid or Red, others more dark seated in a clammy Matter) is lodged the body of the Red Crassament, coated with a deep Purple or Blackish hue, and is a considerable part of the mass of Blood, interspersed with numerous minute white Filaments, which cannot be well discerned, as being clouded with the opaque body of the Red Crassament, except when the Vein is opened, and the Blood received into warm water, which washing the serous Liquor from the Red fibrous parts, causeth the round White Filaments to discover themselves by swimming on the surface of the Water: And the fine threads of the Blood being embodied with the serous potulent Matter, produceth the Hypostasis of Urine, which is wanting in ill habits of Body, by reason their Urine is commonly turbid, as having no Hypostasis, very frequent in crude watry masses of Blood, destitute of well elaborated Fibres, when in an adust mass of Blood too, the Chyme is not concocted into proper Filaments, with which the Red Crassament of well-tempered Blood, is highly furnished.

The Blood consisteth of many White Filaments.

And it may be expected, that I shall give an account, how this Crassament cometh to be tinged with a Red colour, which (as I humbly conceive) is derived from subacid and sulphureous Particles, often circulating with, and dissolved by the heat of the Blood, and blended with its Mass, which may be rendred in some manner plain, by the artificial operations of Chymistry, whereby the saline and chiefly the acide Particles being mixed with

The cause how the gross part of the Blood becometh Red.

fulphureous, give a Red tincture, as in the distillation of Nitre, which aboundeth with sulphureous Atomes; and the affusion of a few drops of Oil of Vitriol, or Sulphur, made upon Liquor or Conserves, that have only a blush of Red, giveth them immediately a more deep tincture of the same colour.

The reason why the Chyle not well attenuated, doth not put on its Red array.

But some may object how cometh it, that the Chyle is not arayed in Scarlet, by reason its liquid substance is impregnated with Salt and sulphureous parts, which do not impart a Red hue to the Chyle, because its Elements are in a state of crudity, as not being sufficiently attenuated, till they have espoused a union with the mass of Blood, wherein they grow more concocted and spirituous by a constant digestion of heat, and repeated circulation with the mass of Blood through the Heart.

The Blood is pale in obstructed Virgins.

The Blood is very pale in Maids afflicted with the Green Sickness (as it is vulgarly called) springing from a crude and indigested mass of Blood, wherein the fixed Salt, and gross sulphureous Particles, are not well attenuated, and associated with the substance of the Blood.

And it is well known to most Artists, well versed in Chymical Operations, that the mass of Blood is not only compounded of the constituent part of Crystalline Liquor, and Red Crassament, embodied proper Vessel; but doth also associate with other integral parts, saline, sulphureous, airy, watry, and earthy Atomes, as the different Elements which make up its Mass.

The sulphureous parts of Blood.

As to the Sulphureous, they may be clearly proved by our nourishment; because we frequently Treat our selves with sweet, oily, fat Aliment, which being concocted in the Stomack, and transmitted to the mass of Blood, doth generate and support the fat parts of the Body.

The saline parts of the Blood.

And as to the salt Nutriment, it imprinteth the same disposition on the Blood, which may be extracted out of its Mass by Art, clearly demonstrating the many Particles of Salt, which may be evinced by the power of Nature too, by reason the salt Atomes of the Blood, are separated by the Glands of the Kidney, and confederated with its serous parts, and afterward conveyed by the small Channels of the Ureters, into the larger Cistern of the Bladder.

The airy parts of Blood.

As to the Airy parts of the Blood, we need no better arguments to prove it, then the florid froth, mixed with Blood by inspiration, and is sometimes coughed up in great quantity, when the vessels of the Lungs are lacerated or corroded by the sharp particles of the Blood; and it is very agreeable to Reason, that the volatil, saline, and sulphureous parts of Blood should be governed, as receiving a due allay from the more fixed and cool parts of Earth and Water.

The spirituous parts of Blood.

In order to a further demonstration of the Elementary parts of Blood, I will add the clearness of Sense to the authority of Reason, plainly deducible from Chymistry in the distillation of Blood, whose moist vapours being elevated by the force of an intense Heat (the volatil Particles being deeply immersed in the more fixed and earthy) do ascend the sides of the Alembick, where they are condensed into drops, making a clear transparent Liquor somewhat resembling the Spirit of Wine) impregnated with volatil, sulphureous, and saline Atomes; the sulphureous betray themselves in a stinking Smell, and the saline in a brackish pickant Taste, seated in the Spirit of Blood, which being drawn off, next ascend the grosser sulphureous parts, under the form of a blackish Oil, which by reason of the *Empyreuma*, hath a most fatide offensive Scent. Lastly, The saline parts of the Blood incorporated with its Flegme, rise by the sides of the Alembick, till all the other

other Elements are extracted out of the earthy parts, leaving them debased into a dull insipid Matter, commonly called *Caput Mortuum*, and Salt too, which being frequently calcined, doth degenerate into this sluggish Body.

The *Caput Mortuum* of Blood.

And now the different *Active* and *Passive* Elements of the Blood, being discoursed, do fairly usher in a History of its Motion, which is differenced by local and intestine, of which the last is more intricate, as being compounded of subtle Heterogeneous Particles, *Actively* and *Passively* concurring, not as Essential, but integral parts (perfective of the Blood) of which the more active and spirituous are always upon the wing, ready to take their flight from the Blood, were they not depressed by the more fixed and grosser, which are attenuated and refined, till they receiving greater and greater exaltation, by the expansion of the more subtle parts, do contribute their Mite to the completion of the Blood.

The more volatile parts of Blood, are depressed by the more gross and fixed. The Blood is heightened by intestine and local Motion.

And the Blood is not only exalted by gentle intestine Motion, but more and more heightened by local too, which is first of all performed in the seminal Liquor, and as being a fluid Body, cannot govern it self, so that it is put under another's dispose, the covers of Membranes every way encircling it, to confirm and secure it from extraneous Matter, about these Membranes. The Blood beginneth its first stage of Motion, caused by the ambient heat of the neighbouring parts, which colliquates the more spirituous portion of the seminal Liquor, which becoming vital near the confines of it, is afterward propagated in a gentle stream by channels (cut through the viscid Matter) uniting themselves in the *Punctum Saliens*, as in a small Cistern; so that the original of the Motion, belonging to the vital Liquor, is caused by extraneous heat, without any impulse made from the Circumference to the Center, from the outward part of the seminal Liquor (adjoining to the *Amnion* and *Chorion*) passing through minute Ducts, the first rudiments of Veins, ending in the *Vesicula Pulsans*, where by its tremulous Motion, beginneth the first impulse of the Blood, making Rivulets through different Channels of Arteries, growing smaller and smaller toward the ambient parts of the seminal Matter; whereupon this may be called the retrograde Motion of the Blood, impelled by the *Punctum Saliens* from the Center to the Circumference. But the first Motion springeth from the ambient parts of the colliquated Seed, where the first rudiment of the Blood is discernible, before the rough draught of the veins is made; And when the Veins, Heart, Arteries, Lungs of the *Fœtus* are perfectly formed, a greater current of Blood is transmitted out of the *Vena Cava*, by the *Foramen ovale in arteriam venosam*, and so conveyed into the Left Chamber of the Heart, and thence impelled into the Trunk of the *Aorta*. And after the *Fœtus* is born, it is receptive of greater proportion of Aliment, which being concocted in the Stomach, is afterward imparted to the mass of Blood, which being highly increased, enlargeth its territories, and quitteth the Anastomosis, with which the *Vena Cava* correspondeth with the venous Artery; so that the *Foramen Ovale* being shut up after the *Fœtus* is born, the Blood hath a free access to the right Chamber of the Heart (before uninhabited) which being straightened by the contraction of fleshy Fibres, throweth the stream of Blood into the pulmonary Artery, which is thence conveyed by the Veins into the Left Ventricle, and afterward by the mediation of the Ascendent and Descendent Trunks of the great Artery and their fruitful branches to all parts of the Body, giving them Life and Heat, which is primarily excited in the vital Liquor, from the heat of the *Uterus*, which reviving its faint innate Heat, colliquates, and more and more expandeth one part of the Infant Blood after another, by raising

The heat of
the Blood is
exalted by
Motion.

raising its gentle flame by soft Motion, toward the *Vesicula Pulsans*, by whose repeated Motions, the heat of the Blood groweth more and more exalted, as the Heart becometh more perfect and abler to make more strong vibrations, the chief instruments of vital heat; to which I conceive, the intestine Motion of the Blood may somewhat contribute, as the sulphureous Particles have an inbred heat, and constant volatil inclinations to their flight, were they not inclosed within the confines of Channels, and detained by grosser parts of other Elements, which are enobled by the warmth and subtilty of the Sulphureous spirits, ever acting upon the *passive* Elements, subduing and raising them to some greater degree of assimilation by intestine Motion, which in some manner is productive of innate heat in the Blood, which is heightened, or depressed according to the greater or lesser intestine agitations of the volatil sulphureous Particles, which would soon grow faint and extinguished, were they not supported and advanced by the repeated Motions of the Heart.

The various
principles of
the Blood.

Blood as well as other Liquors is constituted of sulphureous and saline Particles, as its integral parts; whence it may be reasonably inferred, that the Blood compounded of them, must consist of several unequal parts, some subtle, others gross, some volatil, others fixed; Whereupon the vital Liquor is more or less disposed to Fusion, and Attenuation, as the more Intense or Remiss heat, acteth upon the various Elements of the Mass of Blood, and colliquates, and attenuates the more subtle and less fixed parts, rendring them more and more spirituous by divers periods and progressions, so that these highly attenuated and exalted Particles, are Entitled Spirits, by reason of their great subtilty and agility, not as they were Bodies existing of themselves, separate from the purer, and volatil, saline, and sulphureous Particles, with which the vital Spirits have great affinity, and concur as integrals of the Blood, as being its more noble, subtle, and active parts, sustained and exalted by Motion and Heat, which being deficient, these spirituous parts of the Blood, lose their vigor and activity, as being condensed, and coagulated with the other more gross and fixed parts, which is most conspicuous in extravasated Blood, as being soon destitute of Heat as well as Motion.

Having in some sort described the Motion of the Blood, and Heat, as an effect and consequent of it; I conceive it proper now to render you some account of the composition of it, as it may be diversly considered according to the several Liquors; some being constituent, or Elementary, others Vehicles, or Recrements of the Blood; as to the first, the Red Crassament is fraught with hot oily Particles, and the albuminous Liquor, is impregnated with more mild volatil Salt.

A Comminu-
tion is made
of the various
Elements of
Blood by a
brisk Motion
against the
sides of the
Ventricles.

The disagreeing Airy, Earthy, Oily, and Saline Principles, are founded in the different Christalline, and Purple Liquors, which are associated with Lymphatick and Potulent Matter, the divers Vehicles of the Blood; and as they concur in fusion, making up the mass of vital Liquor, cannot incorporate with each other, without Solution and Liquefaction; and more particularly, no Oily Matter can embody with a Saline, except they receive a most exact comminution, breaking them into small Particles in some liquid substance, as a *Menstruum*, or Vehicle, which is very well accomplished in the Ventricles of the Heart, by a brisk Motion of dashing the Blood against its walls, caused by many impetuous vibrations, made by the repeated Contractions of the strong Fibres of the Heart; so that all the different Elements of the Blood, when they are reduced to minute Particles, consisting of divers Figures, and sizes

sizes, do meet with Pores in the different Liquor, answering them in proportion, and the Magnitudes and Figures of the Elementary Atomes, and Pores of the Blood, are so exactly modelled in a fit likeness, so that the configured Particles are embodied with each other, in a most strict and near union of mixtion.

And Lastly, The Chyle meeting with the Lympha, in the common receptacle, is transmitted by the Chyliferous Ducts, to the Subclavian Vessels, when it commenceth an association with the Blood; and this White Liquor being in its own nature very crude, hath its spirituous Particles, highly engaged or immersed in gross Oily, Earthy, and Saline, which confine the more refined operations of the Chyle, from exerting themselves till it is farther exalted by the heat of the Blood, colliquating the grosser Elements of the Chyme, more and more hightened by an intimate converse and mixture with the Blood, made by frequent Contractions of the Heart, breaking the Chyme into most minute Particles, which espouse a most near conjunction, as blended with, and at last assimilated into Blood, which I conceive is not matured, when the Chyle is first entertained into an association with Blood, but is more and more colliquated and attenuated in the warm Chambers of the Heart, and afterward hath its crude parts rendred more spirituous, by associating with nitro-aereal Particles in the substance of the Lungs, and often addresses to the Heart in repeated circulation, productive of greater and greater exaltation of the Chyme.

And the several Elements mixed with the Purple parts of the Blood, being ambulatory to its temperament, do fairly lead us to it, which according to the Antients, is a result and harmony, immediately flowing from, and made up of the four first qualities, which being endued with contrary dispositions, do act and re-act *in mixto*, till fitly subduing each other, they obtain such a Mediocrity of temper, the proper instrument ministerial to all the functions of the Soul; so that according to this Hypothesis, the temperament of the Blood, is a union of the four qualities, reduced to Mediocrity, which may be considered in a double Notion; First, when one quality somewhat over-powereth another, yet so far as it is consistent with the bond of Mixtion, and is commonly styled *Temperamentum ad justiciam*, in reference to distributive Justice, as observing a Geometrical proportion, according to the dignity of the person: But the other temperament being that *ad pondus*, is when the four first qualities equally ballance each other, to a great exactness in Arithmetical proportion: This temperament, (as I humbly conceive) is meerly imaginary, as being only in conceit, and never in act, by reason it is very difficult to reduce the contrary disposition of Elements, to a perfect æquilibrium; which being supposed, it could not continue in that temperament a moment, when the various temper of the Air, and the different qualities of Aliment, would soon pervert this exact Crasis of the Blood, and produce a different temper, which would soon debase this absolute Eucrasy.

And I humbly conceive, that the temperament of the Blood, is not only seated in the Mediocrity of the first qualities, relating to the Element of vital Liquor, but may have a reference to the Second too, whose due proportion does produce, or at least assist the intestine and local Motion of the Blood, the great Instruments and Conservators of Life.

The Blood consisteth of Airy, Oily, and Saline Elements, as Active Principles, and Serous, and Earthy, as Passive, which being broken into small Particles, do incorporate with the mass of Blood; And these different, if not

The temperament of Justice, according to Geometrical proportion. The Temperaments according to Arithmetical proportion.

The Active and Passive Elements of the Blood.

contrary Principles being mixed in most minute Bodies, duly united, do countermand each others, disagreeing qualities. The cool and moist disposition of Air, gives an allay to the hot and oily; its volatil and thin parts, exalt the fixed Salt, and gross Oil of the Blood, rendring its solid consistence more liquid and fluid, as it appeareth in the Chymical operations of Spirit of Sulphur, and Vitriol, which forced by heat, arise in dry streams, and ascend the sides of the Campana, where they being embodied with Air, do descend in Liquid forms, and are commonly called Oils, but are truly Spirits, arising from fluid Salts of Sulphur and Vitriol.

And on the other side, the gross Sulphur, or Oil, fixed Salt, and earthy Particles, do depress the over fierce and thin oily, and do check the extravagant volatil aspirings of the Saline and spirituous parts of the Blood, by confining them to their proper stations.

The Air, Lympha, and serous Particles do moisten and attenuate the Red Crassament, and crude Chyme, rendring them thin and fluid, by putting them into a fit capacity of Motion, to comply freely with the contraction of the Heart.

CHAP.

CHAP. XXII.

Of the Pathology of the Heart, in relation to its Substance and Blood passing through it.

HAVING discoursed the natural Structure of the Heart, as a noble Engine of Motion, consisting of great variety of parts, set together in an excellent order; I will now use my endeavour, with your leave, to shew how the choice Oeconomy of Nature is discomposed by various Diseases, offering many violations to the regular temper and motion of this choice Machine, by which the Blood maketh its circuit through all parts of the Body, to impart Life and Heat, the great preservatives of the stately Fabrick of Mans Body.

The Diseases that principally disorder the frame of this curious Organ of Life, are variety of Fevers, Inflammations, Abscesses, Ulcers, obstructions of its Ventracles, produced by Worms, and different kinds of concreted Matters.

The prime subject of Fevers is the Heart, as the Blood is acted in it with an unkindly Heat, and is thence communicated by Trunks, and greater and less Arterial Branches into all parts of the Body.

This disorderly Fermentation of the Blood, is much heightened by the violent Motions of the Heart, dashing the vital Liquor against the inward Walls; whereupon its inflammatory disposition is highly intended, appearing in stronger Pulsations, and the intolerable heat of the *Præcordia*, and vehement Thirst, very much afflicting Patients in this fiery Disease.

This unkindly fermentation and heat of the Blood, vehemently troubling the Heart, seemeth chiefly to depend upon two Causes, either its due Crasis, or Temperament is disordered by the undue mixtion of its Elements, or by the too much exalted Principles of Spirit, Salt, and Sulphur; or Secondly, by the innate ferments of the Heart (as famous Dr. *Willis* and others will have it) much rarefying the Blood, in its passage through the Chamber of this choice Muscle; whereupon its frothy effervescence is much increased, and is impelled out of the Ventracles, and through the channels of various Arteries with great violence into all parts of the Body.

Learned *Borellus* maintaineth an Hypothesis, that a Fever doth not proceed from an inflammatory indisposition of the Blood, or from its putrefaction, or from an unnatural fermentation, arising out of the Heterogeneous Elements of mixed Saline, and Sulphureous Particles, but from the sharp Spirits or Atomes of the nervous Liquor, as it may be seen, *Parte Altera de Motu Animalium*, Pag. 460. *Spiritus (Ait ille) seu succi nervi solito redditi acriores, nervos, & cor irritantes, sunt causæ productivæ primæ, & immediata excandescentiæ febrilis.* This famous Author confirms his Opinion, Pag. 466. *Comprobatur ex febrili motu, qui exoritur, dum pus conficitur in pustulis, & ulceribus, in quibus succi pravi pus efficientes, & fermentantes, non per Venas ad cor, sed per nervos ad cerebrum traducuntur. Quod suadetur ex eo, quod Cor nihil fere afficitur a contactu similium succorum fermentatorum, ut patet ex transitu puris pleuritici per Cor. Quare prædictus succus fermentatus pustularum, qui valde mordicare nervos ibidem desinentes potest, facile veneficam suam qualitatem cerebro, & hinc Cordi commotionem communicare potest, ejusque ritum alterare, febremque efficere,*

The Heart is the subject of Fevers.

The first cause of a Fever, is the unnatural temperament of the Blood. The Second Cause of it is the Blood, too much exalted by Ferments.

Borellus his Opinion that a Fever is not produced by an undue Fermentation of the Blood, but from an acrimonious nervous Liquor, and proveth his Hypothesis, by reason the Pus of Pleurisy doth not disaffect the Heart, but the Brain.

efficere, to the beginning of the Paragraph, that the fermenting *Pus* of Ulcers is not carried to the Brain by Veins, but by Nerves (which he after instances in a pleuritical *Pus*) I take the boldness to speak this return, that the terminations of the Nerves being very small, or not capable to receive a purulent Matter, which is gross, and convey it through the straight Interstices of the Filaments to the Brain, which is attended with a greater improbability, by reason the constant Motion of the nervous Liquor from the Brain through the Nerves, must necessarily resist the retrograde Motion of the *Pus*, or else a contrary Motion of different Humors, must be admitted at the same time in the same vessels, which I humbly conceive implieth a Contradiction, that the nervous Liquor should have a Flux from the Brain, and the purulent Matter to it, at the same time through the same Nerves.

About the middle of the said Paragraph, the Renowned Author saith, that the Heart is little or nothing affected with the passage of the *Pus*, which is transmitted to the Right Ventricle, by the veins of the *Pleura* and *Cava*, and not by Nerves to the Brain; and with deference to this Author, that I am not of his Opinion, because I have seen one Mr. *Echins*, a Patient of mine, afflicted with a great Fever and Faintness, when in an Ulcer of the Lungs, the purulent Matter was conveyed by the pulmonary Vein into the Left Ventricle of the Heart, and from thence through the descendent Trunk of the *Aorta*, Emulgent Artery, Vein, and Ureters into the Bladder, and from thence excerned with the Urine through the *Urethra*; so that I saw a great quantity of *Pus* settled with the Urine in the bottom of the Urinal.

The Authors Opinion, that a Fever doth proceed from a nervous Liquor stagnant in the Nerves by reason their terminations are shut up, either by a quantity of Blood, or viscid Matter, obstructing the extremities of the Nerves.

Ingenious *Borellus* proceedeth to give a farther account, how the nervous Liquor degenerates, and becometh the cause of a Fever. In fine, Pag. 471. *Animadverto, quod succi illi destinati, at Nervis expellantur, deponanturque in Glandulis, fieri potest, ut casu aliquo detineantur in eisdem Nervis, obturatis nimirum meatibus & ostiis Nervorum in Glandulis desinentium, ob plethoram, vel ob gluten aliquod in eis contentum, hi vero succi retenti in Nervis degenerare facile possunt fermentatione quadam in alienam naturam animali noxiam*; In this Paragraph, he sheweth how the nervous Juyce being stagnant in the Interstices of the Nerves (terminating into the substance of the Glands) doth acquire an ill nature, by reason the extremities of the Nerves belonging to the Glands are shut up (as I conceive) either by compression, produced by a quantity of Blood, lodged in the Glands, in a plethorick Constitution; or by some viscid Matter (like Glue) obstructing the terminations of the Nerves; so that they cannot transmit the nervous Liquor into the Glands; Whereupon it having lost its Motion, groweth sharp; which being granted, the difficulty will yet remain, how this ill nervous Juyce can be transmitted to the Brain, which sendeth a perpetual Flux of Liquor, first into the origins of the Nerves (seated in the Cortex) and from thence through the several Trunks and Branches to the Fibrils, ending into the substance of the Glands; so that this constant motion of the Liquor, flowing from the fountain of the Brain in divers soft streams, through the Interstices of the Filaments, to the terminations of the Nerves, doth hinder the reflux of Liquor from the extremities of the Nerves toward the Brain, as I have more largely proved above: Whereupon the stagnated acrimonious Liquor would with greater probability produce Convulsive motions in the tender compage of the Nerves, to disburden themselves through this extremity, into the body of the Glands, rather than recoil by a contrary Motion, through the Interstices of the nervous filaments into the Brain, and by other Nerves be thence conveyed to the substance of the Heart, and raise a Fever.

This

This Great Author to make good his Hypothesis, denieth a Fever to proceed from the fermentation, or effervescence of the Blood, whereby the Heart is not irritated to make frequent pulsations, as he hath it much after this sense; *Parte Secunda de motu animal. Pag. 446. Febris (Ait ille) non accenditur a sanguine alterato, fermentatoque, neque ob mordacitatem ejus Cor irritatum Febrilem excandescientiam efficit.* But by the leave of this excellent Author, I humbly conceive, that a Fever proceedeth from the unnatural intestine motion of the Blood, as it is made up of different Liquors, and Elements, associating with the Nervous, Chymous, and serous Juices, and the animal Liquor coming from the Brain, is transmitted through the Nerves, into the substance of the Muscles, and Glands of the *Viscera*, and all other parts of the Body, where its near part confederates with the Blood; and if its Recrement is not conveyed into the Lymphæducts, the nervous Liquor groweth sharp, and much disordereth the Crasis, and due Fermentation of the Blood, and disposeth it to a Fever.

This Author denieth a Fever to be derived from the effervescence of the Blood.

If the Chyme being crude, and not easy to be assimilated, meeteth with a mass of Blood, too highly impregnated with sharp and sulphureous Elements, ariseth an ebullition of the Blood, oftentimes productive of a Fever.

The indigested Chyme is a cause of a Fever.

The serous Particles of the Blood, being watry and saline, being too exuberant, as not severed from the purer parts of the vital Liquor in the Renal Glands, do vitiate the temper of the Blood, and incline its hot mass to an effervescence.

The watry and saline parts of the Blood incline to a Fever.

The mass of Blood is not only composed of different Liquors, but of various Elements too, of Spirit, Sulphur, and Salt.

The Spirituous as the more subtil and volatil parts of the Blood, are bound and kept in due order by the more fixed; whence ariseth a good Fermentation; but if heterogeneous Particles of crude Chyme not easily to be subdued, be mixed with the Blood, the bond of Mixtion is relaxed, then the spirituous parts are too predominant, and the ebullition of the Blood is raised, often ending in a Fever.

The spirituous parts of the Blood not well regulated, do produce a Fever.

When the sulphureous part is too much exalted, as being triumphant in the mass of Blood, its temperament is perverted; whereupon the Chyme being not well Concocted, as being over bilious, doth raise a great effervescence of the Blood, inducing a Fever.

The sulphureous parts of the Blood, too much exalted, cause a Fever.

If the saline Atomes of the Blood be too much elevated, they are brought to a Fluor, and the Blood turneth Acide, which is found to be the cause of a Quartane Ague.

The saline parts brought to a Fluor, do generate into a Fever.

These being premised, it is most probable that the Causes of various Fevers are seated in the Blood, as it is made up of divers fermentative Liquors and Elements, producing many Feverish Inflammatory Dispositions.

The cause of a Fever is seated in the Blood, as compounded of divers Fermentative Liquors.

But the nervous Liquor cannot be so truly said the cause of Fevers (as most acute *Borellus* will have it) as being a mild Liquor, not consisting of many several Liquors, contrary Principles, and Recrements, with which the Blood is endued, and therefore the animal Liquor is not subject to so many various Ebullitions, and Feverish indispositions.

The Nervous Liquor being soft, cannot be said to be a cause of a Fever.

Farthermore, the apertion of a Vein, and the critical evacuations of Blood by the Nostrils, Hemorrhoids and *Menstrua* in Women do determine a Fever, which plainly evinceth, that the Morbifick cause in a Fever is seated in the mass of Blood, whose hot steams, and watry saline Particles, are severed from the Blood in the cutaneous Glands, and discharged by the excretory Ducts of the Skin.

Many critical evacuations of Blood determining a Fever, do shew the cause to be placed in the Blood.

And in order to the more clear understanding of the nature of Fevers, consisting in the various ill Crasis of the Blood (disturbing the Motion of the Heart) I will give you a short History of the various constitution of the Blood, as productive of its Ebullition in the Heart.

The tempera-
ment of the
Blood, as com-
posed of Four
Humours.

Galen and his followers made four Temperaments, supposing the mass of Blood to be compounded of four distinct Liquors, Phlegme, Bile, Melancholy, and laudable or pure Blood; but I conceive it will be very difficult, according to this Opinion, to solve the *Phænomena* that may occur; so that it seemeth more probable to determine the Blood (as well qualified) to be one Liquor, consisting of Heterogeneous parts, and not of those different humors, which do not constitute the mass of Blood, but are only accidental to it in a depraved habit of Body, in which three of those humors may be called Recrements of the Blood (and not constituent parts) which Nature endeavoureth to seern from it, and therefore it is more consonant to Reason, and Sense, not to believe the Blood to be made of many distinct Humors, but one Liquor consisting of different parts, pituitous, framed of crude indigested Chyme, or bilious, made of exalted Oily Particles, or melancholick, compounded of Tartareous, or earthy, Saline, put into a Fluor, as the chief Spirituous and Oily parts are breathed out.

The melan-
choly consti-
tution of the
Blood.

Hence spring the four Constitutions of the Body, derived from the several Temperaments of the Blood, when it is integrated of different Elements, reduced to a good harmony in due proportion; The constitution of hot, oily, and saline Particles not too much exalted, nor the gross and fixed too much depressed, and the solid and liquid Atomes well mixed, may be truly stiled the Sanguineous temper of the Blood, and is the rule from which the others may be termed more or less ill, as they have greater or less deflections from it, as being ill tempers upon which the *Pathology of the Blood* dependeth.

The sangui-
neous consti-
tution of the
Blood.

The Pituitous
constitution
of the Blood.

The First I will Treat of, is the Pituitous Constitution, derived from cold, moist, or gross Aliment, not well concocted, for want of a fit *Menstruum*, or good natural heat, whence proceedeth an ill prepared Chyle, conveyed through proper Channels to the Heart, where it being not well attenuated and colligated, runneth confused with the Blood, without being broken into small particles, by reason of its over viscid substance, generating a crude mass of Blood, which being imparted by great and less arterial Branches to the whole Body, maketh a cold and moist temperament, commonly called *Pituitous*, seated in a gross mass of Blood, apt to be stagnant, which produceth various inflammations in reference to several parts, in which the crude Blood is lodged, *vid.* a *Perinnumonia* in the substance of the Lungs, and *Pleuritis* in the *Pleura*; An *Angina* in the Muscles of the *Larynx*; A *Polypus* in the Ventricles of the Heart, and the Trunk of the pulmonary Artery and Veins; An Apoplexy in the substance of the Brain, and an *Anasarca* in the habit of the Body.

Some Physicians, and those Learned too, do conceive the Phlegmatick mass of Blood to be composed much of Chyle, or nervous Liquor, as being akin in colour and manner of consistence) Whereupon it being thick and indigested, when extravasated and Cold doth concrete into a white and discoloured Cruor, or skinny substance, facing the upper region of the Blood, when it is let out of the Vein into a Porringer, and coagulated.

The Cause of
the tough sur-
face of the
Blood.

But upon a more curious inspection, this white, clammy, tough surface of the Blood, will be found to be a Fibrous contexture, made up of many thin Membranes, seated one within another, in whose Interstices are formed a reticular Plexe, composed as it were of nervous Fibrils, interspersed with

with divers small Cells, (resembling little holes interceding Combs, filled with Honey) in which a serous Liquor is contained.

The Compage
of the Blood
when it is co-
agulated.

This Compage of the Blood may be made evident by ocular demonstration which I saw in concreted Blood, covered with a white Surface, almost halfe an inch thick, which was integrated of many fine Membranes, as so many thin Flakes, constituting this coagulated Systeme, framed of numerous Filaments, curiously interwoven, and closely set together, which I discerned by my naked Eye, without the help of a Microscope; and also many small network Plexes, interspersed with *Arææ*, or little Loculaments, affixed to the inside of the Membranes, as so many Repositories of the ichorous Liquor of the Blood: And afterward upon a deeper search made into the more interior recesses of the Blood, I discovered first a reticular Plexe, full of Cavities tied to the inside of the Membrane, constituting the lowest Membrane of the white viscid texture, finely wrought with interwoven Filaments, pinked with many holes, as so many allodgments of the Purple Liquor, divided also into many Fibrils, which run in length downward, making an elegant Compage, beset with curious Embroidery, made up as it were of nervous Filaments, adorned with Interstices of divers Figures, as so many minute Receptacles, big with Red Liquor in the lower region of the Blood let out into a Vessel, and concreted; the structure of the Blood seemeth to be more loose then the Crust swimming a top, as framed of Filaments endued with larger Cavities, which are receptive of the Red Crassament, or rather (as some will have it,) a black melancholy Liquor the Faces of the Blood, in whose Pores, as well as in the Interstices of the white coagulated Liquor, is lodged an ash-coloured pale Serum, somewhat resembling the concreted albuminous matter of the Blood, or the White of an Egg.

And to the oblong Filamentous Productions, propagated through the Red mass of coagulated Blood, are appendant divers small reticular Plexes interlining the spaces of the long Fibres.

And the Body of the concreted Blood being washed in divers waters, hued before with Red, whereby the Serum being parted from its Receptacles (many Plexes making the fine Network) may be seen arayed in White; and as they are longer and longer gently washed, the Whiteness coating the fibrous contexture of the Blood, may be more clearly seen.

And besides these white and fibrous Particles, which are the first *Stamina*, giving a bulk and body to the Blood, the most eminent are the Red Particles, enclosed in many Cells and Filaments, and being highly attenuated with Motion, do intimately associate with the albuminous part of the Blood, and wholly obscure it.

In this Crystalline Liquor are seated the fine volatil Salts (attenuated and dissolved by Heat and intestine Motion) which are the chief ingredients constituting the Ferments of the *Viscera*, helping the Stomack and Intestines in the concoction of Aliment; out of which a white tincture is extracted, the *Materia Substrata* of Blood. And it is very probable that the fibrous parts of the Blood are propagated from small Capillaments, which being united, do constitute many thin Filmes in the Body of the vital Juyce, and more thick and tough Membranes, cloathing the upper region of extravasated Blood. The Filaments are very visible in the Concretions of Salt. The contrary Principles of the Blood affecting Dis-union, and Concretion; whereupon Nature hath contrived with great Artifice, the Confederation of various parts by Motion, which rendreth them Fluid, least the Heterogeneous Elements should be divorced from each others embraces, by a kind of precipitation

cupitation; to this end the Grand Architect hath made a great *Apparatus* of Organs, the Heart and its appendants, as so many Engines and Channels dedicated to the *Motion of the Blood*, that its little Filaments, and Filmes, might be broken into small Particles, and pass through the small Pores and extremities of the capillary Arteries and Veins; and the Compage of the Blood gaineth a disposition to be fluid, as acted with the intestine Motion of its proper parts, which agreeth to all Fermented Liquors, and agiteth, and attenuates the integrals of fluid Bodies, by bringing them to a high Comminution, whereupon they become more moveable, and acquire greater freedom in a restless agitation of Parts, which being of a different nature, are preserved in union by a constant and continued Motion.

On the other side, the Blood groweth gross, and apt to be Stagnant, when the Fermentation is very much Dispirited, as the several Liquors of vital Juice are not well filtred in the Interstices of the Vessels, relating to the Conglobated Glands of the *Viscera*, giving to the Blood many unnatural Films and Filaments, whereby it acquireth an over-gross Fibrous disposition, apt to concrete into Membranes, and White conglobated Bodies, producing prolypse coagulations, often found in the Heart, Lungs, Veins and Arteries, which I intend more freely to discourse in the diseases of the Heart.

The bilious
Constitution
of the Blood.

Another ill constitution of Blood, proceedeth either from a hot, and sharp nourishment, and more free Cups of generous Wine; as also immoderate eating of Oil, and Meats highly seasoned with Spices, or from the inward Compage of the Blood, abounding with hot oily Particles, conveyed to all coasts of the Body, which do render it hot and dry, called the Bilious Constitution, which furnisheth the Blood with inclinations to Intermittent, and Continued Fevers; the First is differenced by Tertian, Quotidian (by reason the Quartan is proper to a melancholick temper) commonly called Agues in our Tongue, of which the Tertian, if single, is distinguished by its accession every other day, and if double, every day,

The oily Particles of the
Blood, the
cause of an
Intermittent
Tertian Fever.

I humbly conceive the *Materia Substrata* of this disease, is seated in an over bilious mass of Blood, impregnated with large proportions of subtle oily Particles, rendring it unable to subdue the quantity of indigested Chyme, by not breaking it into very minute portions, in reference to assimilation, which cannot be accomplished, by reason of the hot Diathesis of the Blood, which being not capable to reduce the crude Chyme to a perfect association, is put upon a great ebullition in the Heart, sending forth toward the ambient parts, very hot *Effluvia*, which arriving, the *Membrana Carnosa* force it into great Concussions, commonly called Rigors, which begin the Scene of the Paronyfme, relating to an Ague; in which the more hot steams, carried with great fierceness by the Capillary Arteries to the surface of the Body, produce the state of the Fit; and lastly, the fiery exhalations being associated with the ferous recrements of the Blood, do end in steams of Sweat, which distilling through the miliary Glands and Pores of the *Cutis*, do freely bedew the surface of the Body; whereupon the Tragick Scenes of the Fit do close in a pleasant interlude of an *ἀμυψία*, the matter of the Paronyfme being breathed out by a free transpiration, and the Patient is treated with a grateful Repose, till a plenty of fresh Crude Alimentary Liquor is transmitted to the bilious mass of Blood, which is perverted into nitrous sulphureous Particles, causing an inordinate effervescence, beginning a new Scene of another Paronyfme of a Tertian Fever, which often degenerates into a double Tertian, called by some a Quotidian, which in truth is very different from it, as being a double Tertian, because every other

other days Fit doth answer in Measure and Time; and one Paroxysme invadeth every day; often caused by ill Diet, producing a great proportion of ill concocted Chyle, every day transmitted to the mass of Blood, overcharged with hot oily Particles, which being severed from other Elements of the Blood, do embody with each other, causing an inflammation of the Purple Liquor whence its Compag is loosed in some part, and rendred incapable to unite with the crude Chyme, as not being broken into minute Particles, by reason of its indigested viscid substance; whereupon the Heart being highly aggrieved, is put upon inordinate Contractions, making a great Motion and Effervescence of the Blood, endeavouring to discharge its fierce steams through the exterior parts, by a free Diaphoresis, and plentiful Sweat.

It may not be altogether improbable, that Intermittent Fevers may arise from a vitiated *Succus Pancreaticus*, degenerating into a more or less Acide indisposition, according to the time of Stagnancy in the substance of the Pancreas; whereupon the more volatil Particles of the Pancreatick iuyce, contempering the Acide, do lose their spirituous ingeny.

Fevers proceeding from a vitiated *Succus Pancreaticus*.

The Stagnancy of the *Succus Pancreaticus* proceedeth from the obstruction of the excretory Ducts of the Pancreas, (leading into the Guts) caused by some gross pituitous Matter, lining the inside of the First or Second Intestine; so that the pancreatick Liquor cannot be discharged into the Cavity of the Guts, and thereupon recoileth by many excretory Ducts, into the substance of the Pancreas, and is from thence carried into the origen of the Veins, and afterwards into the *Vena Cava*, and right Ventricle of the Heart, where it making an Effervescence, doth produce a Tertian or Quartan Ague, according to variety of Paroxysms, the one happening every other day, and the other every Third, according to the greater or less Acidity of the Pancreatick Recrements.

Another cause of Stagnation of the Pancreatick Juyce may arise from its grossness, as not being commensurate in its Atomes, to the Shape and Size, of the extremities of excretory Ducts of the Pancreas; whereupon this Pancreatick Liquor is received into the roots of the Veins, and then into the *Cava*, and Right Chamber of the Heart, wherein this Heterogeneous Liquor mixeth with the Blood, and putteth it into a Febrile Fermentation, by raising an Ebullition, which is quieted by throwing off the hot Steams through the Excretory Ducts of the Skin.

Of this distemper of Intermittent Fevers, proceeding from the obstructed Ducts of the Pancreas, Learned Graaft giveth an account, *Tractatu de Succo Pancreatico*, Cap. 2. *Obstructionem in Pancreatis ductibus observavimus in Femina Febrem intermittentem passa, in cujus Dissectione, per Syringam infudimus liquorem volatilem & caeruleum in Ductum Pancreatis majorem, ex quo in plerisque Ductus laterales penetrabat, dum in perpancis propter obstructionem fistebatur, unde dicto colore inficiebatur ipsa Pancreatis substantia in uno loco, & non in alio.*

Having given you a short view of Intermitting Fevers, proceeding from an ill concocted Chyme, transmitted by proper Vessels to the mass of Blood, (disordering the Heart) predisposed with a Feverish disaffection, springing from too much exalted oily Particles; I conceive it may now be opportune to speak somewhat of Continued Fevers, which admit no perfect *ἀπαυξία*, but only a remission, and are therefore more dangerous, because a hot inflammatory temper is not only made (as in intermittent Fevers) but also the Mixtion and Compag of the Blood is in some degree loosned, as its Liquor is turgent with luxuriant spirituous oily Particles too much exalted; whereupon the

Continued Fevers have no perfect intermission, but only a remission.

Elements of the Blood are set much at liberty, and run confused in the vital Liquor, as not duely confined within the bond of Mixtion, so that the Spirituous and Volatil parts of Blood, moving to the Ambient parts, are breathed out through the Pores of the *Cutis*, whereby the vital Liquor groweth very faint, as made destitute of many Spirituous Particles.

Three kinds
of Continued
Fever.

The Continued Fevers are for the most part reducible to Three kinds, The First may be called *Ephamera*, seated in the most subtle and spirituous parts of the Blood, which are inflamed by a great Effervescence somewhat dissolving the volatil oily parts of the Blood in the Chambers of the Heart, which are moved with frequent pulsations, to squeeze out this troublesom inflamed Liquor.

Febris Eph-
mera.

The *Febris Ephamera* is often quickly appeased, as being founded in the thin volatil Atomes of the Blood, which do evaporate through the secret passages of the Skin, in insensible transpiration, and more free dewes of Sweat.

The restricti-
on of the
Pores is one
cause of a
Continued
Fever.

The Second kind of Continued Fevers hath for its Procatarctick Causes, a hot and moist temper, often accompanied with a corpulent habit of Body, derived from luxurious Diet, and frequent Blood-letting, which highly increase the oily parts of the Blood, in the place of Saline taken away; whereupon persons accustomed to be often let Blood grow fat, as having their Blood filled with oily parts, and rendered obnoxious, to acute continued Fevers, proceeding from the less thin and volatil Atomes inflamed, as the natural Crasis of the Blood is perverted by want of a due Ventilation upon the restriction of the Pores of the Skin, coming from the coldness of the Ambient Air, wherein the hot steams of the Blood, are unduely confined within the Body; so that the too highly exalted sulphureous part over-pouring the other Elements, do somewhat unty the bond of Mixtion, and in a great proportion associate with each other, producing a great Ebullition of Blood in the Ventricles of the Heart, which is stiled by the Antients a putrid Fever, but is now rejected by many, because the Blood as long as it is acted by motion, cannot well be liable to putrefaction; yet in reference to the Aduft Oily Particles, the temper of the Blood is very much violated, and the natural union of the integral parts much infringed, highly tending to putrefaction; a Continued Fever may be in some sort truly termed Putride, and hath divers Steps commonly called Types, wherein as in so many Stages, the Continued Fever taketh its course, and by several Types and Periods, as so many intermedial paces of accessions and remissions; the acute Fever arriveth its *αρχή*: The first step of the Disease is called by *Galen* *ἀρχή* the rise or beginning of it, which first betrayeth it self in an unnatural Effervescence of the Blood, arising from a violent eruption of combined oily Particles, communicated by degrees to the mass of Blood, and this continueth for three days or more, during which time the Morbifick Matter remaineth crude and unseparated from the mass of Blood.

A putrid Fe-
ver.

Ἀρχή, or
The begin-
ning of a pu-
tride Fever,

The Second
step or time
is commonly
called
ἀύξησις

The Second step or time of a Continued Fever (stiled by the Author *ἀύξησις*) is when the unnatural heat of the Blood groweth more intense every Fit, derived from a great quantity of inflamed oily Particles, which though they most eminently appear in the *Præcordia*, as parts confining on the Heart, (in which the Effervescence of the Blood is chiefly seated, yet these hot oily Particles of the vital Liquor are also diffused thence, through the whole mass to all parts of the Body. The increase of this hot Disease continueth for three or four days, or thereabouts, more or less, according to the greater or less degrees of acuteness of the Fever, when the first glimmerings of the Concoction

Concoction begin to dawn in a small secretion of the impure adust Particles from the purer Blood, which at this time of the Fever is discovered in the Urine, growing more clear toward the Surface, as the grosser parts begin to precipitate toward the bottom of the Urinal.

The third step of a Continued Fever (named by that Great Master of our Faculty, *ἄκμῃ*, the state of the Disease,) wherein the Ebullition of the Blood in the Heart arriveth to the highest degree, proceeding from a great confederacy of numerous Oily Particles breaking forth as it were into a flame, through all the apartments of the Body, and in the state of this Fever, the two great Combatants, Nature and the Disease, do briskly enter the list, making violent thrusts at each other upon the account of life and death; whereupon they both highly endeavouring a conquest, one of them loseth the day, sitting down in a loss of victory, while the other triumpheth in the pleasant success of Life, happily changing the *ἄκμῃ* of the Disease into a *παρακμῇ*, the state into a declination, which is the fourth and last stage of this Fever, succeeding the state, wherein the Vital Spirits the more active and volatil parts of the Blood triumph as conquerors, and the Febrile heat is receptive of an allay, and the most eminent signs of Concoction appear, as the *Crisis* of the disease is instituted by Nature; whereupon the secretions of the recrements of the Blood are made, whereof some are oily, and others Volatil Saline, embodying with the serous parts of the Blood (being put into a *Flux*) which are conveyed from the greater Arterial Branches to the Extremities of the Capillaries terminating into the Skin, which being very Porous, receiveth the fierce *Effluvia*, and serous Recrements of the Blood, freely besprinkling the ambient parts of the Body. And this I humbly conceive is the best, and most natural *Crisis* of a Fever, when the Morbifick Matter is universally expelled through the habit of the Body.

But the *Crisis* (I conceive) is less perfect and beneficial, when more particular Evacuations of the peccant Matter are instituted by Nature, as when the Pores of the Skin being shut up by ambient cold, a *Crisis* is sometimes ordered by a Hemorrhage through the Nostrils; when the inflamed oily, and the exalted saline Particles being in high commotion with the mass of Blood (cannot be protruded by plentiful Sweats in a free transpiration) are translated into distant parts from the Heart, and being hurried by impetuous motions of the Blood through the internal Carotide Arteries, into the Membranes and Cortex of the Brain, are thence conveyed by the Internal Jugulars into the Nostrils. Whence the danger of their *Crisis* is, lest some part of the Morbifick Matter should be conveyed with the Blood into, and so fixed in the substance of the Brain, as to vitiate the Animal Liquor, and thereby produce a *Delirium*, Convulsive Motions, as the *Subsultus Tendinum*, and many other Cephalick distempers.

Again (I conceive) another *Crisis* may be made in a continued Fever by another particular Evacuation, when the gross Adust Particles are severed like a *Caput Mortuum* from the Blood after its Deflagration, and are transmitted by the emulgent Arteries into the substance of the Glands relating to the Kidneys, wherein a Secretion is made of the Morbifick Matter with the serous Particles from the more refined Blood; and transmitted first through the Urinary Ducts into the *Pelvis*, and thence by the Ureters, as Aqueducts into the Cistern of the Bladder, which appeareth in a reddish Urine, when first

The 3d step of a Continued Fever is called *ἄκμῃ*, or the height of it.

The fourth step of a continued Fever, called *παρακμῇ*. The declination of the disease.

The first *Crisis* of a continued Fever when the Matter of the Disease is evacuated by Sweat.

The second *Crisis* of a continued Fever discharged by a Hemorrhage of Blood through the Nostrils.

The third *Crisis* is made when the Matter of the Continued Fever, is discharged by Urine.

first made, which a little while after groweth thick and turbid, and is afterward precipitated; So that the Adust Particles, the more gross Contents having recourse to the bottom, the substance of the Urine groweth clear and transparent.

CHAP. XXV.

Of Malignant Fevers.

The nature of
Malignant Fe-
vers.
The Symp-
toms of Ma-
lignant Fe-
vers.

THe third kind of Continued Fevers, commonly called Malignant, differeth in substance from the rest, and ariseth from the mass of Blood secretly envenomed with some noysome Miasmes, whence immediately ensueth a suddain dejection of strength, wherein the temper of the Blood being violently disordered, its Compage is perverted, and its Mixtion is in a great part dissolved, as the Elements, the integral parts of the Blood, are in a manner separated one from another, attended with horrid symptoms, *vid. Stupor, Delirium*, Convulsive Motions, the trembling of the Tendons, and the like, the same kind of accidents, which accompany the drinking of Poyson, or the biting of Vipers, and other venomous Animals infecting the Blood with subtle venenate Atoms, small in quantity, but great in power (destructive to the constituent principles, relating to the mass of Blood) which is discovered in the speedy perverting the *Crisis* of the Vital and Nervous Liquors; whereupon the functions of Life, Sense, and Motion are ill celebrated; So that the harmony of temper belonging to the Blood is disordered, and the Oeconomy of Nature violated, the dismal forerunners of death.

If a curious search be made (for the better understanding of Malignant Fevers) into the nature of Poysons, what alterations they make in the consistence of the Blood, they will be found very different, by reason some Poysons making a fusion of the Blood, do precipitate its serous parts; others do produce Swellings, by throwing the malignity of the Blood into the extreme parts, and do impel the serous Recrements by the terminations of the Arteries inserted into the Cuticular Glands, wherein a separation being instituted by Nature, the serous parts do puff up the *Cuticula* and make *Pustles*; which I saw in a Person of Honour, a Patient of mine poysoned with Arsnick, in whom the sulphureous and saline Particles of the Blood being highly enraged, do produce a great ebullition of Blood, emulating the Fit of a Malignant Fever, which was at last discharged by the eruption of numerous Pimples (filled with the Serum of the Blood highly precipitated) besetting the *Cuticula* of the whole Body. Sometimes the Spirituous parts of the Blood are highly evaporated by poysonous Miasmes, wherein the particles of Salt and Sulphur are so highly exalted; that the Blood becometh ictterical, by too great an affation; So that it is sometimes hued with Yellow, and other times with Black.

The Blood is
coagulated,
putrefied, and
the bond of
Mixtion high-
ly disordered
in malignant
Fevvers.

And there are other Poysons of another nature, which are more dangerous, as destructive to the Compage of the Blood, in producing first a Coagulation, and afterward Putrefaction; So that the Spirits of the Blood being

evapc-

evaporated, the equal Mixtion is dissolved, and the grosser parts being associated, do quit the Serous Particles, and the poysonous Miasmes infecting the Blood, do cause it to Coagulate somewhat after the manner of Milk mixed with Runnet; whereupon the red Crassament is rendred Grumous, as well as the Chymous parts, whence ariseth the *Polypus* of the Heart, as also Syncope and Lipothymies, &c.

The way of communicating poysonous steams to the Vital and Animal Liquor, in reference to the production of Malignant Epidemical Fevers, is from the Air by inspiration, wherein many saline and sulphureous Mercurial, Arsenical, and other Exhalations of the same figure and nature (coming from poysonous Minerals of the Earth) being confederated and received into the Lungs, do mix with the mass of Blood: These *Effluvia* being of a most subtle disposition, do insinuate into the Blood, sometimes precipitating it by the separation of the Serous Particles from the more thick Purple Liquor, and other times making it stagnant in the Vessels and Ventricles of the Heart, do generate a coagulation of the Blood, producing dreadful symptoms.

The Malignant Vapours residing in a poysonous Air, make impressions more readily in ill masses of Blood, full of sulphureous Particles easily breaking out into a feverish flame, especially in timorous persons, wherein the steams of infected Air are speedily conveyed inward with the Blood into the Chambers of the Heart.

The way of
Infection in
Malignant Fe-
vers.

K 9

CHAP.

C H A P. XXIV.

Of Intermittent Fevers.

A melancholy
constitution
of Blood.

A Quartan
Ague.

The cause of a
Quartan
Ague.

The reason
why Quartan
Agues have
longer inter-
missions than
other Inter-
mittent Fe-
vers.

HAVING given in some sort a Narrative of Diseases in reference to Pe-
tuitous and Bilious Recrements; I shall now take the freedom to
speak somewhat of the Distempers of a Melancholick Constitution of Blood
sprinkling from gross Aliment, abounding with earthy parts and fixed Salt,
which being above measure exalted, are productive of an Acid indisposition,
which being elevated to a great height, maketh it degenerate into a *Fluor*,
wherein the Saline before espoused to the oily and earthy Particles, do suffer
a divorce from them; So that the bond of Mixtion is in a great part dissol-
ved in the mass of Blood, and the Saline parts being not under the controul
of the Elements, have a kind of absolute power, as commanding the Com-
page of the mass of Blood; whereupon the spirituous and sulphureous Par-
ticles being much evaporated, the Saline do exercise a dominion over the
rest, by inducing an *Acor* to the whole *Mixtum*, relative to the Blood, from
whence sometimes proceedeth a Quartan Ague, differing in types and periods
from the Tertian, as having its accession every third day; and its continent
cause is assigned by the Antients, to a Melancholick humor putrefying in
the lower apartment of the Bo y; But I humbly conceive it more rea-
sonable that the origen of a Quartan Ague is in the Vital Liquor, whose sweet
Balsamick quality is debased into an acide and austere indisposition, in which
the spirituous and oily parts being much withdrawn, the Tartareous (con-
sisting of earthy and Salt parts) are too much heightned to a *Fluor*, productive
of Acid Particles, which are carried by the greater Channels of Arteries to the
smaller, and cause Concussions in the *Membrana Carnosa* (in the beginning of
the Paroxysm) which when violent, are called Rigors, when more remis
are termed Horrors; and these Convulsive Motions accompany the first rise
of the accession, and when the heat followeth, the Increment of the Fit
beginneth, and when the unnatural heat arriveth to a height, the Fit cometh
to a state, and when the ebullition of the Blood is abated, the declination of
the Paroxysm appeareth, which terminateth into a plentiful Sweat.

The reason why the Periods of a Quartan have longer Intervals than
those of a Tertian, is, because the distemper of the Blood, tending to
Acid, is more remis in heat, disaffecting the Chyme in a less degree, per-
mitting somewhat of Assimilation into Blood, and the perverting the other
Particles of it, do not make so great a disorder, as is found in a Tertian;
So that the *Materia Substrata* of the Blood being less depraved in a Quartan,
doth more slowly fill the Vital Liquor with indigested Particles, and the Sa-
line Atoms being more moderate in heat, require longer time before the
peccant Matter is exalted, producing an Ebullition in the Heart, the conti-
nent cause of a Quartan, which hath often a most difficult Cure, and is
long afflictive, because it is derived from an Acid Dyscrasie of the Blood,
which

which is not easily redressed by Medicines; whereas the bilious indisposition consisting in an effervescence of Vital Juyce, proceeding from an association of oily Particles, is more speedily discharged by a free transpiration; but a Melancholick Constitution, springing from a depauperated mass of Blood, hath its more spirituous Particles retired from it, and the saline and earthy parts are too much exalted; And therefore Purgatives alone are not available in a Quartan Ague, in which the fixed Saline parts of the Blood must be rendred Volatil, and the lost sweet Balsamick repaired by Medicines Dulcifying the Acid, and by impregnating them with oily spirituous Particles, which is of as great moment as difficulty to effect.

The Cure of
Quartan
Agues.

And also in an acid disaffection of the Blood, when its laudable portion is over-powered with a too highly exalted Salt, it is rendred dispirited, productive of a *Fluor*, whence arise the great variety of Scorbutick diseases (abounding in numerous symptoms, Emulating divers Distempers) proceeding also from concreted saline Particles, transmitted from the mass of Blood, and vitiating the Nervous Liquor, whence is propagated a prodigious offspring of Chronick diseases, as the *Strumæ*, Rheumatisms, Gouts, Scabs, Scurf, Cancers, Leprosies, and the like.

CHAP.

CHAP. XXV.

The Cures of Intermittent Fevers.

THe diseases of the Blood (afflicting the Heart) being Intermittent, Continued, and Malignant Fevers, I will now (having heretofore discoursed their Causes) propound some short means of their Cures, derived from several Indications.

As to the most urgent and chief Indication, That the great effervescence of the Blood may be taken off, Vomiting, Bleeding, and Purging, are very important. Vomiting Medicines do clear the Stomach of gross, pituitous, bilious, and acid humors, and put the Ventricle into a good capacity to concoct Aliment by extracting a laudable alimentary Tincture, which is the *Materia Substrata* of Blood, whose constant decay of Spirits is repaired by good Chyle; whereupon Intermittent Fevers flowing from undue Chyme, are often Cured, or much alleviated in more gentle Paroxysms; by Vomitories also the Bilious Recrements are thrown out of the Liver by the common Duct into the Intestines, whereupon the Blood is rendred more pure as severed from its adust Particles of Sulphur and Salt.

The opening a Veing in a Plethorick constitution of Body, doth by lessening the quantity of Blood, give a more nimble Circulation, and also an allay to the great Ebullition of Blood, the continent cause of Fevers.

Gentle Purgatives consisting of opening, cooling Medicines, do take away the obstructions of the Liver, and freely discharge the bilious humors out of it, and the Blood, and so rendereth it cool and depurated from its Oily Recrements.

The second Indication in Intermittent Fevers, is taken from the inhibition of a depraved Chyme, which is performed by exact rules of Diet, that it might be thin, and of easie Concoction, and not over sweet, oily, and too spirituous; So that generous Wines being taken, must be mixed with serous or watry Liquors, which subdue the sulphureous and spirituous parts of the Blood, in reducing it to a good temper by checking its great Ebullition.

The third Indication is taking of the Paroxysm of Intermittent Fevers by proper Specificks, as by several kinds of *Decocta Amara*, mixed with some cooling Julaps; and the Cortex of *Peru*, a most powerful and safe Medicine, may be given after the Body is well prepared by Vomitories, Purgatives, and Venæsection, cooling and cordial Julaps, made of Pearl, do highly temper the Blood, and Testaceous Powders are proper in Fevers too, as promoting Sweats, and insensible transpiration, breathing out the fiery steams of the Blood.

Salt of *Carduus*, or Wormwood given with Conserves of Wood Sorrel, as also in a Specifick *Menstruum*, mixed with a few drops of Oyl of Vitriol, or Sulphur, which do give a check, and often take away the Fits of Intermittent Fevers, by appeasing the immoderate heat and fermentation of the Blood.

The first Indication denoteth Vomitories, are proper in Intermittent Fevers.

Opening a Vein is good in a Plethorick Constitution, in case of these Fevers.

Gentle Purgatives and cooling Julaps may be safely administered.

The second Indication denoteth good Diet is very beneficial in this case.

The third Indication is satisfied by Specificks.

C H A P. XXVI.

Of the Cure of Continued Fevers.

AS to the Cure of Continued Fevers, The one proceedeth from the accession of the Volatil and spirituous parts of the Blood, called *Febris Ephemera*. The second is produced by the more sulphureous Atoms inflamed, styled *Continua*, as being without any perfect *ἀνepsία*. The third kind is named Malignant, as derived from poysonous Steams, either precipitating the Blood into serous Particles, or coagulating its red Crassament or the Chymous part (the Matter of Blood) which is found in *Polypo Cordis*, à *Chymo in Ventriculis Concreto*.

Febris Ephemera, consisting in the subtle parts of the Blood inflamed, hath three Indications ; The first is the Remotion of the Procatartick cause, as the immoderate heat of the Sun, or assumption of generous Wines, playing in hot Baths, violent exercise, and the like.

The first Indication of a *Febris Ephemera*.

The second Indication in this Fever supposeth the thin oily parts of the Blood to be allayed by cooling Juleps, or discussed by plentiful Sweats, or a free insensible transpiration.

The second Indication of this Fever.

The third denoteth a deflagration of the Blood, in reducing it to its proper temper and mixtion, by the perfect assimilation of the Chyme into Blood, and the secretion of its Recrements in various Colatories, which is accomplished by Blood-letting (making good its Motion) as also by a thin Diet, and temperate Aperient, Diuretick, and Sudorifick Medicines discharging the Blood from its inflamed Volatil, and more gross feculent Particles.

The third Indication of this Disease.

As to the Therapeutick of a Continued Fever of many days, it is made up chiefly of three Intentions, in the first it is requisite to quench the fiery sulphureous parts of the Blood ; or at least to mitigate them, which is the second ; and the third is, to throw off the adust Recrements, when the deflagration of the Blood is very much alayed.

The Indications of a Continued Fever.

About the beginning of this Fever, gentle Clysters may be administred, and Bleeding too is very proper, in a Plethorick Body, to lessen the mass of Blood enraged with inflammatory minute sulphureous Particles, and a spare Diet is to be used, made of thin Broths, prepared with cooling Herbs, as also strained Barley-Gruel, Water-Gruel, Barley-Cream, and the like.

Clysters, Bleeding, and cooling Juleps are very proper.

And in the increase of this Disease, if the Pulse be high, and the Vessels much distended with Blood, attended with a want of Sleep and great pain of the Head, a Vein may be opened the second time, and blistering Plaisters applied between the Shoulders, and to the inside of the Arms, Thighs, Legs, and Cataplasms to the Feet.

Bleeding is very good in a Plethorick body, and in the beginning of the Disease.

In the state of a Continued Fever, Bleeding is not so proper, except in a most exuberant mass of Blood, attended with a *Phrenitis*, *Angina*, *Perineumonia*, *Pleuritis*, or some other great inflammation of the *Viscera* ; and a most slender Diet is to be observed in the height of this Fever, lest Nature being overpowered with Aliment hard of Concoction, should be diverted from its proper work of conquering the Disease, by making a Secretion of the adust from the more refined parts of the Blood, and by discharging them by gentle Sweats through the Cutaneous Glands and their Excretory Ducts terminated to the outward Skin.

Diaphoreticks are proper in Continued Fevers.

Eating of
Flesh is very
dangerous in
Continued
Fever.
A gentle
Purge may be
given in the
declination of
a Continued
Fever, *si vires
ferant.*

In the declination of the Disease, care must be taken lest Flesh be eaten (before the Fever is some time gone) which consisting of Heterogeneous parts will put the Blood upon a new Fermentation, and increase the Inflammation of the Blood, which hath often proved fatal to the Patient: If the strength of the Patient be not brought very low, a gentle Purge may be advised to carry off the reliques of the disease, and cleanse the Stomach and Guts of gross Excrements, and to render them fit for concoction and distribution of Aliment.

And when the Fever is discharged, it is requisite, in order to preserve the Patient in health, to advise him to begin with Broth, new laid Eggs poched, and afterward to eat Fish, easie of digestion before the free eating of Flesh.

A Malignant Fever proceedeth from Air infected with poysonous steams, whereupon the mixtion of the Blood is dissolved, and the various Elements severed from their intimate union, and the Purple Liquor Concreted, and the more serous Precipitated, and the Animal Juice vitiated, which is accompanied with a great difficulty of breathing, a *Delirium*, Convulsive Motions, Vomitings, universal Horrors, tremblings of the whole Body, Syncopes, Lipothymies, *vid.* greater or less fainting Fits, &c.

This Fever is called Malignant or Pestilential, by reason of its venenate nature, in which it resembleth the operation of Poyson taken into the body, which produceth the same symptoms, and is akin to this Fever in the types and periods of its Paroxysms: Of this case I will give you a most remarkable instance of a Patient of mine, basely poysoned by a Servants Mother (contrary to all duty and gratitude) putting a quantity of Powder of Arsenick into Coffee-water.

An instance of
a Gentleman
Poysoned
which had the
same types
and p.riods
with a Malignant
Fever.

A Knight of the Bath, a Person of great Fortune, Vertue, and Honour, about eleven a Clock the Third day of October, 1676. drunk two dishes of Coffee, and immediately Vomited with great violence, and so continued about ten hours, in which (he conceived) he vomited thirty times, which was accompanied many hours inwardly with a great heat and thirst, with an universal horror or coldness affecting the whole surface of the body, which was acted with general Convulsive motions of the Muscles, and trembling of the Nerves and Tendons, whereupon his strength was so dejected in a very few hours, that his Legs could not support him, and his Pulse grew quick, weak, and sometimes intermitting; he laboured also with a great difficulty of breathing, which was now and then for some short time intercepted, and then returned again; he was also afflicted with a high *Flatus*, distending his Stomach and Guts, productive of great tensive pains: These symptoms or some of them at least, affected him from the taking of the Coffee till Wednesday at noon, and then had some alleviation till about two on Thursday morning, and then many of the former accidents returned (much aping a Malignant Fever) and afflicted him till about eleven a Clock on the same day, and then had ease all the afternoon, and fore part of the night till two the next morning, and then the Fever and symptoms were renewed, and held him till about eleven the same day, so that this Malignant Disease and symptoms, lasted at first for two days and nights, and afterward lasted but nine or ten hours in Four and twenty, for six or seven days more; and upon the application of proper Cordials, and great Doses of Oriental *Bezoar*, he had free Sweats for five or six days together, which brought out an innumerable company of Pimples (full of Serous Liquor.) besetting the whole surface of the Skin, which spake a period to the Disease, to the Glory of God, and the Joy of his Physician and Friends.

CHAP. XXVII.

Of the Diseases of the Heart, and their Cures.

HAVING done with the various kinds of Fevers, I will now with your permission Treat of other Diseases relating to the Heart, beginning with an Inflammation, which proceedeth from a quantity, or from thickness of Blood, impelled out of the beginning of the *Aorta*, into the Coronary Artery, and out of the terminations of its Capillaries, is transmitted into the empty spaces of the Vessels (appertaining to the fleshy Fibres of the Heart) where it groweth Stagnated, as not being in a capacity to be received into the minute Origins of the Coronary Veins; whereupon it being some time extravasated in the carnous Fibres of the Heart, doth gain an unnatural Effervescence, highly discomposing the Motion of the Fibres, in order to make good a due Systole of the Heart; whereupon ensueth an Intermittent Pulse, flowing from an exuberant quantity of Blood lodged in the Ventricles, as not able to be discharged by the contraction of the weakened, inflamed, and tumefied carnous Fibres, which produce Lypothymies, Syncope, and palpitations of the Heart.

The cause of
an inflammation
of the
Heart.

If the Blood be long extravasated in the fleshy Fibres of the Heart, it loseth its Native bounty (as wanting intestine and local Motions) and degenerates into a corrupted condition, whence ariseth an Abscess, derived from a collection of Matter, lodged in the empty spaces of the Vessels, belonging to the carnous Fibres of the Heart, which being Corroded by the Acrimonious Particles of the Pus, do discharge it into the more enlarged Cavity of either Ventricle; whereupon an Abscess becometh an Ulcer, which is a Flux of Pus or sanious Matter, out of the substance into some Cavity of the inward parts, or thrown out of the Confines of the Body, by the corruption and perforation of the *Cutis* and *Cuticula*.

An abscess of
the Heart.

An Ulcer of
the Heart.

An instance may be given of an Ulcer of the Heart (flowing from an Inflammation and Abscess) in a Citizen, afflicted with the deadly symptoms of a Fever, Lypothymies, Syncope, &c. and the Thorax and Ventricles of his Heart being opened, were found to be filled with thin stinking sanious Matter.

An instance of
the Ulcer of
the Heart.

To prevent this fatal stroke, caused by Abscesses and Ulcers of the Heart, the only way is timely to take off the Inflammation, before the Disease getteth too great a Head, which is done by free and repeated Bleeding in a plethorick Constitution, which emptieth the Coronary Vein into the *Vena Cava*, and Right Ventricle, whereby the Coronary Blood-Vessels may be in some degree emptied, and the Stagnancy of the Blood (in the Interstices of the Vessels) taken away by the reception of it into the extremities of the Vein.

The Cure of
an Inflammation.

As to the Fever cooling and opening Apozemes, mixed with gentle Diureticks, are very proper, which do cool and attenuate the hot and gross Blood, and take off its aptness to Stagnate, by promoting its more dull Motion.

The Cure of
a Fever, relating
to an Inflammation
of the Heart.

As to Syncope and Lypothymies attending Inflammations of the Heart, Pearl Emulsions are very advantageous, adding to each Dose, many drops

of

of Spirit of Hartshorn, of Salt Armoniack succinated, Compound Spirit of Lavender, Spirit of Saffron, &c.

The obstructions of the Ventricles of the Heart, proceeding from divers causes.

The Ventricles of the Heart are liable to many Obstructions, proceeding from variety of Matter, sometimes with Stones, produced by a Lapidescient quality of the Blood, turning the Tartar of it (composed of many Saline and some earthy Particles) into a hard stony substance, lodged in the Chamber of the Heart; whereupon the contracted Fibres cannot perfectly close with each other to squeeze the Blood out of the Right Ventricle into the pulmonary Artery, and out of the Left into the Trunk of the *Aorta*, whence arise an Intermittent Pulse, Lypothymies, Syncopes, and Palpitations, caused by a quantity of Blood (lodged in the Cisterns of the Heart) threatening a Suffocation. These sad symptoms are also attendants of an obstruction of the Heart, produced by Caruncles growing in the Ventricles, generated out of gross red Filaments of Blood, united together in the form of Vessels, interlined with reliques of the Red Crassament, so that these concreted parts of Blood, seem to resemble a fleshy substance, which being adherent to the walls of the Ventricles, made of fleshy Fibres, do intercept their Contraction, and give a great check to the motion of the Vital Liquor.

The Ventricles of the Heart obstructed by a Polypus. The cause of a Polypus.

The Ventricles of the Heart are also liable to an Obstruction coming from a white Concreted Mucous Matter, called a Polypus, from the likeness it hath, with a Fish in Figure; The cause of it is (as I humbly conceive) the white Fibrous part of Blood (which maketh a crust or clammy membranous substance, when extravasated) consisting of many long Threads, somewhat resembling nervous Filaments, which do much contribute to the Body and Compage of the Blood, by which it Concretes when it hath lost its Motion and Heat, as extravasated; These oblong Filaments in an ill mass of Blood not well attenuated, do not wholly pass the Ventricles of the Heart, and do stop while the more thin and Spirituous, well attenuated parts of Blood do run into the Lungs, so that by degrees, the gross Fibrous parts do more and more associate, and being Concreted, do clog the Cavities of the Heart, and sometimes through these Fibrous gross parts of the Blood (having their Compage loose, as not perfectly coagulated) the more subtle and fluide parts of the vital Liquor, do insinuate and make a Channel, and make good the Circulation through the Right Ventricle into the Lungs, and afterward by the access of new gross Fibrous parts, the Filamentous passage is wholly closed up, and the Polypus compleated, filling up the Right Ventricle, pulmonary Artery, Vein, and Left Ventricle.

Concreted Blood is made up of many White Filaments.

If any Man shall doubt the truth of this Concretion of Blood in a Polypus, as being made up of many white Filaments, or little Cells, in which the serous and Red parts of the vital Liquor are lodged, he may discover this Fibrous Contexture (after the manner of a membranous Compage, made up of open Fibres) when the Blood is despoiled of its Red array, by frequent washings in fair water; whereupon, the white Filaments, giving solidity to the Blood, may be clearly discerned; as also the many vesicles, entertaining the Albuminous parts of the vital Juyce, as so many small repositories, making a kind of reticular Compage, which is replenished with a Diaphanous, and more light Liquor. If a more deep inspection be made after the Ambient parts have been viewed, into the more inward recesses of extravasated Blood, where the concreted Particles grow Red, the Fibrils may be seen interspersed with divers *Sinus*, immuring the Red Atomes of Blood, and if a farther search be had into its lower Region, it becometh hued with a Purple or deep Red, (beset with the ultimate production of more loose and

large, vulgarly and improperly called Melancholick Blood. And the whole extravasated Mass, both in the bottom, middle, and crust, or surface, is intermingled with a concremented *Serum*, coated with a pale Ash-colour, somewhat resembling the White of an Egg; And moreover, if the extravasated Blood be highly inspected, many oblong Appendices, or Filaments, may be seen passing through the whole Compag, to which the numerous Vesicles (containing the Serous and Red Particles of Liquor) are appendant.

That the Truth of this Hypothesis may be farther illustrated, how all the parts of the Blood may be styled Fibrous, in reference to its many Filmes, beset with divers Sinus, you may take a Polypus (generated in the Left Ventricle of the Heart) sometimes bespotted with Red specks, and other times endued all over with a deep Red, or Purple colour, proceeding from the Red Crassament of Blood, settled in many Vesicles, or encompassed with divers thin Films. A Polypus is also faced with a White Crust, or high clammy Skin, under which is seated a Red Concremented substance (interlined with many Fibres, resembling the Red parts of Blood).

The mass of Blood is Fibrous.

I have seen a Third Polypus different from the former, which had its outward and interior Recesses clothed with White, and its Ambient parts inclosed in a White Membrane, which proceeded from the Serous or Chymous parts of the Blood (severed from the Purple Particles) which were composed of White Filaments, and Vesicles, containing a White Concremented Liquor, making up the Body of the Polypus, which clogged the Right Ventricle, the pulmonary Artery, Vein, and Left Chamber of the Heart, which I saw in the Heart of worthy Dr. *Timothy Clarke*, (one of His Majesties Physicians in Ordinary) Dissected by Learned Dr. *Walter Needham*, in the presence of renowned Dr. *Croyden*, and Dr. *Belvoir*.

Another kind of Polypus.

The Fibres of the Blood, (if diluted with Liquor, as streaming out of the Vein, and received into hot boiling Water,) grow less, and if they be much boiled, the Filaments of the Blood are conjoyned, and coalesce into a thin Tunicle, very much resembling that which encircleth the coagulated substance of a Polypus.

An Experiment how to discover the nature of Blood.

A Polypus flowing from the Chymous, Serous, or Red part of the Blood Concremented, is more easily, and commonly generated in the Trunks of the Vein, and in the Right Chamber of the Heart, then in the Arteries and Left Ventricle, by reason the Blood after it is much divested of its thin and spirituous Particles, expended in nutrition and transpiration in the habit and cutaneous parts of the Body) and when a gross mass of Blood is confounded with Chyle in the subclavian Veins, its White Fibrous Particles being precipitated by the contiguity of Heterogeneous Atomes, are apt to coagulate in the Right Ventricle, before the depauperated Blood (mixed with crude Chyle,) is exalted and attenuated by the association of nitroaereal Particles in the substance of the Lungs.

A Polypus derived from various Matter.

The production of a Polypus holdeth some Analogy with that of the Stone of the Kidneys, and other parts, as the Stone is made up of divers thin Concremented *Laminae*, closely conjoyned and lodged one above another; The generation of a Polypus may in some manner resemble this of the Stone, as it is a Compag integrated of many thin Filmes (somewhat like the flakes of a Stone) to which are appendant several Sinews, containing Serous and Red Particles of Blood, which being Concremented in the intermediate spaces of the Pellicles, do increase the Body of the Polypus, which is more and more enlarged by the accretions of new Fibres, and Saline Particles of crude Blood.

The similitude in the production of a Polypus with that of the Stone.

Most ingenious *Malpighius* proveth this Hypothesis by a remarkable instance communicated to him by Learned *Borellus*. *Ait ille, in hujus confirmationem licebit his exarare mirabilem Polypi structuram, & magnitudinem Florentiae in sene sexagesimum quartum annum agente inopinatò defuncto observatum, à Doctissimo viro Jo. Alphonso Borello mihi humanissime Communicatam.* In Aorta prope Cor, quæ in tumorem excreverat ad mensuram duorum pugnorum, Polypus consimilis magnitudinis repertus est, absque appendicibus, & Caudis, ejus autem moles membranosis tunicis ad invicem super impositis absque Continuitate con- surgebat, quæ crassitie non superabant vulgarem chartam hædinam: super his producebantur filamenta quædam alba, quæ foliorum fibras, seu vasa æmulabantur, quæ omnia ab albidiori trunco dependebant. Tunicarum Polypum efformantium color cinereus erat cum rubicundis quibusdam maculis, ita ut tota hæc structura brassicam capitata æmuleretur. Out of this History it may be clearly inferred, that the production of a Polypus is made of many Filmes (seated one above another) whose Interstices being kept open by an interceding current of Blood, do somewhat resemble the Leaves of Plants, as the Membranes of the Polypus are composed of divers united Filaments, not unlike the Fibres branched through the foliage of Trees.

Some do entertain themselves with an opinion, that the Membranes of the Polypus hath divarications of Blood-Vessels, which may seem somewhat probable, by reason the small streams of Blood, may be confined within the united Fibres, as within so many Tubes, or Vessels, and after this manner Vessels may be formed in the Colliquaments of Seed in the Uterus of Animals, and in false Conceptions, and in the ascititious Glands, and all other fleshy excrescences.

A Polypus when it cometh to a height is incurable.

This Disease when it hath arrived a height, is incurable, as obstructing the greater Trunks of Blood-Vessels, and the Ventricles of the Heart; whereupon the current of Blood is intercepted, the fore-runner of death; so that a Polypus admitteth no curatory indication, as the Disease is mortal, and therefore it concerneth the Professors of Physick to be careful to prevent this fatal malady in a timely taking away the cause, consisting in a gross mass of Blood, made up of over-fibrous Particles, productive of a Polypus, whose preservatory indication denoteth, in reference to the procatartick Cause, a Serene Air, Diet easy of Digestion, and moderate exercise; and in relation to the antecedent cause, Antiscorbutick, Diuretick, and Chalybeat Medicines, and chiefly *Turnebridg*, *Knowsborough*, and the *German Spaw Waters*, which put the Blood into a kindly Fermentation, in attenuating its grossness by a due precolation from bilious recrements, in the Hepatick Glands, and from fixed Salt (a main cause of Concoction in a Polypus,) in the Glands of the Kidneys.

In the beginning, to prevent a Polypus, Purging and Bleeding is good.

In the beginning of this Disease, Bleeding and Purging will speak a great advantage to the Patient, by taking away the gross Fæculencies of the Blood, and by promoting its circulation through the greater and less Tubes of Blood-Vessels, and through the more enlarged Cisterns of the Heart, in which the Disease is principally seated.

CHAP.

C H A P. XXVIII.

Of the Hearts of great Animals.

THe Heart of other more perfect Animals have much conformity with that of Man, in relation to Situation, Connexion, Figure, and Substance.

The Heart of great Animals are much akin to that of Man.

The Hearts of greater and less Beasts, are conceived to be lodged about the middle of the Thorax, which must be meant of their Bases, and not of their Cones, as somewhat inclining toward the Left Side; and the Hearts of Brutes have their Situation much nearer the middle of the Breast, then that of Mans.

The situation of the Hearts of other Animals.

The Hearts of other Animals, as well as Mans, are Connected to the Back by the Trunks of the *Vena Cava*, and *Arteria Magna*.

The Connexion of the Hearts of Animals.

The Hearts of more perfect Animals are endued with a round pyramidal Figure, and Cetaceous Fish, with a flattish pyramidal shape.

The Figure of their Hearts.

And these of most Animals have a Compage, encircled with a thin Membrane, and made up of variety of Vessels, and many ranks of fleshy Fibres, (interspersed with tendinous and nervous Fibrils) conjoyned to each other by the interposition of strong ligaments, and carnos Branches, that they may not be divided, but assist each other in joynt Contractions in the Systole of the Heart.

Learned *Thomas Bartholine* giveth an account, that he discovered in a Hog, an elegant contexture of Nerves about the Cone of the Left Ventricle, corroborating the fleshy walls of the Heart, and further discerned many perforations about the bigness of a Brisle, which passed quite through the *Septum* of the Heart, from the Right to the Left Ventricle, where he found a Membrane, covering the holes, to intercept the regrefs of any Liquor from the Left to the Right Chamber of the Heart.

The contexture of Nerve about the Cone of the Heart belonging to a Hog.

The Heart of a Pig being opened, the Left Ventricle may be discovered to be adorned with various ranks of carnos Fibres (enwrapping each other) as also the mitral Valves † encircling the Orifice of the pulmonary Veine. The carnos Columns † of this Ventricle are more small and numerous then those of greater Animals; and have many Ligaments † arising out of the tops of these Columns, implanted into the mitral Valves.

The Left Ventricle of a Pig.
† T. 15. F. 44.
† bbb.
† ddd.

These Columns have many Ligaments, † (seated near their small Extremities) fastning them to each other.

† ecc.
† eee.

The Heart of a Lion is bigger then that of other Animals, according to the proportion of his Body, And hath a very hard and firm Compage (as Learned *Borichius* affirmeth) endued with a thick wall in the Right Ventricle, and may be observed in a Dissected Lion, the *Septum* to be extended, the whole length of the Heart, and not to exceed Paper in thickness; and both Ventricles to be stuffed with a glutinous Polypose Matter, and one Valve only to beset before the beginning of the *Aorta*.

The Heart of a Lion.

The Heart of a Land Tortoise resembleth Fish in its Figure, as tricuspidal, and also in one Ventricle, and Auricle, which is very eminent in this Animal, and being blown up, is threefold as big as the body of the Heart, and is hued with a Blackish colour, and the Heart with Red.

The Heart of a Tortoise.

The Heart of
a Camel.

A Camels Heart is wonderful, in reference to its dimensions, as being Nineteen transverse Fingers in length, and Seven in breadth, and is adorned with a very acute Cone, considering the great bulke of the Heart.

CHAP. XXIX.

Of the Hearts of Birds.

The Hearts of
Birds are
alike those
of greater
Animals.

THe Hearts of Birds have great affinity with those of greater and more perfect Animals, both in Figure, Situation, Connexion, and Substance, as having fleshy, tendinous, and nervous Fibres, as large as other Animals considering the proportion of their Body; and the part of the *Septum* adjoining to the Right Ventricle is smooth, as for as any Prominency, but the interior part of the *Septum* is Fibrous; The Lungs and *Aorta* are furnished with Semi-lunary Valves, which are open to give admittance to the Blood passing out of the Right Ventricle into the Lungs, and out of the Left into the *Aorta*; and on the other side, these Semi-lunary Valves, do hinder the regress of the vital Liquor out of the Lungs into the Right Chamber, and out of the Trunk of the *Aorta*, into the Left Ventricle of the Heart.

A fleshy
Valve, sup-
plying the de-
fect of the
Tri-Cuspidal
Valves in
Birds.

The Ingress or Orifice of the Right Chamber of the Heart hath no tri-cuspidal Valves (which are found in great Animals) but a fleshy Valve (endued with a Semi-lunary Figure) supplying their defect, and resteth straight upon the entrance of the Ventricle, facing the Right Auricle, and is open, as giving a Reception to the Blood, coming out of the Termination or Orifice of the *Vena Cava*, into the Right Cistern of the Heart, which being filled with Blood, this Carnous Valve, shutteth up the entrance of the Right Ventricle so close, that the Blood cannot possibly recoil into the Orifice of the *Vena Cava*.

And though the Right Ventricle in one side seemeth smooth and plain, yet the Left Chamber of the heart in Birds of a small size, is every where fibrous, and also furnished with fleshy Columns, which are more prominent then the other Fibres, as having greater Dimensions; and the Left Ventricle is accommodated with mitral Valves, so well contrived by Nature, that the Blood cannot have any recourse into the Lungs, when the Left Ventricle of the Heart is contracted, which may be experimented by cutting of the Cone of the Heart, and by injecting Water into the Left Cistern, so that the mitral Valves are swelled, and joyned close together, whereby the entrance of the Lungs is so stopped, that it hindreth the passage of the Water into the pulmonary Vein, and forceth it all into the Orifice of the *Aorta*, which treateth the Eye with a pleasant sight.

The Heart of
a Goose.

The Heart of a Goose is beautified with a kind of Pyramidal crooked Figure, which is flattish on each side; and its Base leaneth toward the Right, (and its Cone toward the Left side) which is connected to the Back, by the interposition of the *Vena Cava* and *Aorta*.

And by reason in this and other Birds there is no Intersepiment passing between the Heart and Liver (as in greater Animals and Fish) The Cone of the Heart insinuates between the Lobes of the Liver, which are hollowed

lowed in the inside with two Cavities, to give reception to the Heart, as within Sockets, wherein it hath free play in its various alternate Motions.

The Heart of a Pidgeon is large, if a regard be had to its small Body, and is adorned with a Pyramidal Figure, as well as other Birds; its Base is connected to the Back by the mediation of the *Vena Cava*, and *Arteria Magna*, and its Cone is affixed by a Membrane to the Left Lobe of the Liver. Learned *Borichius* saith, the Heart of this Bird is seated in the middle of the Breast, but with deference to this renowned Author, I have seen in a Pidgeon (which I have Dissected) the Heart bending in its Base toward the Right, and in its Cone toward the Left Side: The same Author saith he discovered a little hole, into which he immixed a Hogs Bristle, which passed clean through the *Septum* of the Heart into the middle of the Left Ventricle.

The Heart of a Pidgeon.

Swans, Eagles, Bustards, Estridges &c. have one kind of situation of the Heart, as the Cone pointeth toward the Left, and the Base inclineth toward the Right Side; The Apex also, both in greater and smaller Birds, is lodged in the Cavities, as in cases made in the inside of the Lobes of the Liver, for the Heart to play up and down in its Diastole and Systole.

The Hearts of most Birds have their Base inclining toward the Right, and their Apex toward the Left.

The Left Auricle of the Heart of a Wild Duck, (as well as other Birds, being opened) is found to be composed of many lairs of fleshy Fibres, lodged one within another. †

The Left Ventricle of the Heart of a Wild Duck.

And the mitral Valves † may be seen in the Left Ventricle, encompassing the Orifice of the pulmonary Vein, hindring the reflux of Blood out of the Left Ventricle into the Lungs.

† T. 15. F. 4.

The Heads of the Carnous Columns are Crowned with divers Branches of Ligaments † implanted into the mitral Valves.

† c c.

These Carnous Columns being beautified with a Pyramidal Figure † have many Ligaments † making their progress crosswise, which fasten the many Columns to each other, and keep them in their proper place.

† d d d d.

† e e e.

C H A P. XXIV.

Of the Hearts of Fish.

The Heart of
a Porpess.

The Pyramy-
dal Figure of
the Heart.

The Auricles
of the Heart
beset with
ranks of Fi-
bres, inter-
spersed with
several Fi-
gures.

The Fibres of
the substance of
the Heart tied
to each other.

The Right
and Left Ven-
tricle adorn-
ed with
fleshy Co-
lums

The tricuspi-
dal and mitral
Valves.

The semilu-
nary Valves.

The Heart of
a Thornback,
and its allodg-
ment.

The Figure of
the Reposito-
ry of the
Heart.

The Figure of
the Heart of a
Thornback.

The Figure of
the Heart of a
Skaite.

†. 7. 29. c.
†. d.

THE Heart of a Porpess holdeth great Analogy with that of Man and Quadrupeds, and is beautified with a pyramidal Figure, beginning in a Base, and terminating into a Cone; it is endued with two Auricles, one seated in the Right, and the other in the Left Side, and are furnished with many lairs of fleshy Fibres, intersecting each other, and interspersed with many *Areae* of divers Figures, interceding the numerous Fibres.

The substance of this Heart is made up of many ranks of Carnous Fibres, tied to each other by the mediation of Ligaments, Membranes, and Fibrous Branches, to preserve them from starting out of their natural Situation, in their constant, and sometimes violent Contractions; the Fibres besetting the Ambient parts, are more small, and grow greater and greater, as they more and more approach the inward Recesses of the Heart.

This Fish also is like in its Heart to other more fleshy perfect Animals, in reference to the Right and Left Ventricles, which have many fleshy Columns, adorned with a pyramidal Figure, whose Bases are seated toward the tricuspidal and mitral Valves, and their points toward the Cone of the Heart.

Out of the tops of the Columns do sprout many Ligaments, which are inserted into the tricuspidal and mitral Valves, encompassing the Orifices of the *Vena Cava*, and pulmonary Vein.

The Extream of the *Vena Cava* in the Heart of this Fish, is encircled with tricuspidal Valves, in the Right Ventricle, and the Orifice of the pulmonary Vein seated in the Left, is immured with mitral Valves in the Left Ventricle.

The Orifices of the pulmonary Artery and *Aorta*, are enclosed with semi-lunary Valves, which are Concave, Membranous Compages, beset with many Semi-circular and Right Fibres.

The Hearts of Fish, (except those of a Cetaceous kind) are lodged in a small Apartment, a little below the Mouth, not far from the Gills; This Chamber of the Heart in a Thornback, Skaite, Fireflair, and other cartilaginous Fish is immured in its upper Region (if considered as it swimeth) with a Cartilaginous or Bony cieling, enwrapped above and below with a White Membrane, to secure the Heart from a violent compression (which would intercept the Motion of the Blood) in swallowing of whole Fish.

This Receptacle, or Allodgment, entertaining the Heart of a Thornback, is endued with a round, and somewhat depressed Figure, much larger then the Heart, to give it a free play in order to frequent Motions.

The Heart of this and most other Fish dressed with Gills, is adorned with a triangular, or rather tricuspidal Figure, and hath the *Aorta* (arising out of the Base of the Heart) guarded with a Cartilaginous substance.

The Heart of a Skaite is endued with triangular, or tricuspidal Figure † and hath but one Auricle lodged under the Heart (and runneth cross-wise †

as dissected in a supine posture, and above it as the Fish swimmeth.

This Fish hath a Gland, hued with a yellow colour, besetting the great Artery, near the Mouth, where it emitteth its Branches into the Gills.

A common Trunk ariseth immediately out of the Base of the Heart † and out of the great Artery do sprout a tripartite Branch † on each side, and after a little space ariseth out of the common Trunk, a tripartite Branch †, (which are inserted into the Gills †) from whence are propagated numerous Ramulets, fringing their bony Semi-circles.

The Heart of a Dog-Fish (called by the Latines) *Galæus levis*, is adorned with an inverted pyramidal Figure, its Base † is naturally seated upward, and its Cone † downward, and hath but one Auricle seated under the Heart †, according to the posture of Dissection.

This Fish, as well as other, hath a common Trunk †, (coming immediately out of the Base of the Heart, and hath many Branches † springing out of it.

The Heart of a Lamprey is encircled with a Cartilaginous integument, as being the *pericardium* †, suitable to the Heart in Figure.

The Heart in this Fish is very remarkable, as seeming to be double, consisting of a Right and Left Lobe (which is manifest to Autopsy) the First is seated in the Right side of the Heart † in an Auricle, which is not placed as in other Fish, under the Base of the Heart, but maketh its progress all along the Left Ventricle, and seemeth to constitute another Heart, which being pricked made no motion; but the Left Lobe † or Ventricle, being wounded with the point of a knife, made many vibrations, and was quiet before it was pricked.

The Heart of a Salmon, is adorned with a triangular Figure (which is found in most Fish) and hath only one Auricle (into which the *Vena Cava* is implanted) †, in which, being opened, many greater and less Branches † may be plainly discovered, somewhat resembling the Right Auricle of more perfect Animals. These Fibres are interspersed with many *Arææ*, or Interstices, endued with different shapes and sizes †.

The Ventricle in this Fish is strengthened with Columns †, much assisting the contraction of the Heart, and hath a great company of fleshy Fibres †, seated in several ranks, one lodged above another, as in other Animals; between these Fibres are placed many Interstices † after the manner of Network, finely wrought in various Figures and Magnitudes.

This Ventricle is guarded with a Tendon † seated in the inside, near the Base of the Heart, into which the carnosus Fibres are inserted.

The Trunk of the *Aorta*, (arising out of the Base of the Heart) being opened, two Semi-lunary Valves † may be seen, which intercept the retrograde Motion of the Blood, out of the *Aorta* into the Ventricle.

This Trunk the of *Aorta* is inwardly Embroidered with various Branches † of fleshy Fibres (which render the inward surface full of unevennesses, and much alike the Left Auricle of the Heart) impelling the Blood out of the Trunk of the *Aorta*, into the Arterial Branches leading into the Gills.

The Heart of a Viper † is different in shape from other Animals, as its Origen hath small Dimensions, and its Termination much greater, somewhat resembling a Bladder, which beginneth in a Neck, and endeth in a far larger extent, and its origination adjoyneth to the Termination of the Liver.

The obtuse Cone or Base of the Heart †, relating to a Snake, is seated immediately

The Auricle of the Heart.

The common Trunk of the Artery.

†. e.

The tripartite Branch of the Artery.

†. F.

The tripartite Branch.

†. G.

†. H.

The Figure of the Heart of a Dog-Fish.

†. 32. D.

†. C.

†. e e.

†. A.

†. B. E.

The Pericardium of a Lamprey.

†. T. 38. a. a.

The Right Lobe of the Heart, or Auricle.

†. B.

The Left Lobe of the Heart, or Ventricle.

†. C.

The Heart of a Salmon.

†. T. 15. T. 1.

†. a. a.

†. b. b.

†. c. c.

†. d. d.

†. e. e.

†. f. f.

†. g. g.

†. h. h.

†. i. i.

The Heart of a Viper.

†. T. 41. F. 1.

†.

The Heart of a Snake opened.

†. T. 41. F. 2.

immediately above the Origen of the Lungs, and the Heart endeth in an acute Cone.

†. b.

†. i. i.

The Auricle of the Heart † running in length, and not cross-wise, as in Fish, embraceth a great part of the Right Side of the Heart, out of whose obtuse Cone, or Base, ariseth the Trunk of the *Aorta*. †

CHAP. XXX.

The Hearts of Insects.

The Heart of
a Silk-worm
and its Situa-
tion.

THe heart of a Silk-worm is seated among the Muscles, implanted into the Incisures, and passeth all along the Back from the head to the Extremity of the Body, so that its Pulsation may be obscurely discerned in the Ambient parts, (by the apposition of the hand,) as a Learned Anatomist will have it. I have seen the frequent Vibrations of the heart, when it hath been laid bare, by opening the Body.

The Compage
of the Heart.

Learned *Malpighius* saith, It is a Compage made up of thin Membranes, which in their first rudiments are Diaphanous, and afterward grow opaque, as being rendred Yellow, and afterward Brown, or deeply Red, which are Died with the vital Liquor, hued with several Colours.

The Mem-
branous sub-
stance of the
Heart, is in-
terspersed
with carnous
Fibres.

And I humbly conceive, with Deference to this great Author, That the heart of this admirable Animal, is not only made up of a Membranous substance, but of fine carnous Fibres too, besetting the Ventricle, which is thereby contracted in its frequent Systole, impelling the vital Juyce out of the Chamber of the heart, into the entrance of the great Artery, which being encircled with fine Membranous Valves doth intercept the retrograde current of Blood out of the *Aorta*, into the Ventricle of the heart.

The Heart
hath many
oval small
Tubes, like
so many little
Hearts.

The hearts of most Animals end in a Conick Figure, but in this not one Cone can be seen, nor one continued Cylindrical Cavity may be discovered to be endued with equal Dimensions, running through the White Body of the heart from one Extremity to the other, but there may be found a Duct, made up of many small oval Tubes, which seem to constitute so many hearts, mutually conjoyned, giving assistance to each other, in order to impel the vital Juyce into the origen of the Arteries.

The Heart of
an Epheme-
ron, and
other Insects.

The heart of an Ephemeron, as well as Silk-worms, Bees, Caterpillars, Grasshoppers Locusts, and the like Insects, are seated near the Back, and hath a Ventricle beset with fine fleshy Fibres, which make the Motion of the heart by their Contractions, whereby the Liquor of Life is impelled out of the Ventricle of the heart, into the Origen of the *Aorta*, and from thence through many Arterial Divarications into all the parts of the Body.

C H A P. XXXI.

Of the Arteries of the Heart.

HAVING spoke of the Heart and Blood, it may be now methodical to discourse the Arteries and Veins, as so many Membranous Cylinders, exporting and importing Vital Liquor from and to the Heart.

The Arteries of the Heart are Trunks, attended with smaller and smaller Branches, and Ramulets, as so many fine Tubes of different sizes, transmitting Blood into the Heart, Lungs, and other apartments of the noble fabrick of Humane Body.

The Heart is furnished with three Arteries, the Pulmonary, the *Aorta*, and Coronary. The first being inserted into the upper part of the right Ventricle, hath its Orifice leading into the Lungs, whose substance is adorned with numerous Divarications.

The Arteries
of the Heart.

The Origen of the Pulmonary Artery is beset with Tricuspidal Valves, hindring the reflux of Blood out of the Lungs into the right Chamber.

The Orifice
of the Pulmo-
nary Arteries.

The *Aorta* hath its Orifice placed about the left Ventricle, which first conveyeth Blood into a common Trunk, which hath its first entrance guarded with Semilunary Valves, to give a check to the Retrograde motion of the Blood out of the *Aorta* into the right Ventricle.

The Orifice of
the *Aorta*.

The Orifice of the great Artery is contrived with great Artifice, lest the Blood conveyed with a brisk Impulse, should be unequally distributed into the parts of the Body; and therefore Nature hath made the Arterial Channels of Blood somewhat winding, so that it cannot be transmitted with a rapid current into the Brain, lest it should overflow it and destroy the Animal Functions, by an Apoplectick Fit. To obviate this destructive disease, the All-wise Agent hath so ordered the Trunk of the *Aorta* not far distant from the confines of the Heart, that the Rivulets of Blood should not be carried in a straight course, but in a kind of Meander, into the Axillary and Cervical Arteries; And in the middle space between the left Ventricle and said Arterial Channels, the great Artery taketh its progress with a Circumvolution, that its crooked Angle might sustain the first brisk impulse of the Blood, and divert the greater stream (toward the descendent Trunk of the *Aorta*) which else would be imported with great violence through the ascendent Trunk into the Carotide Arteries, and make an inundation of the Brain.

The Coronary Artery sprouteth out of the Trunk of the *Aorta*, immediately after it taketh its rise out of the left Ventricle of the Heart, before it perforates the *Pericardium*, and encircleth the Base of the Heart, and transmitteth many branches toward the Cone, especially in the left Side.

The Corona-
ry Artery.

This Artery receiveth Blood out of the Trunk of the *Aorta*, and transmitteth it into the substance of the Heart, and chiefly toward its outward surface, which is then discharged out of the *Parenchyma* of the Heart into the Extremities of the Coronary Veins, and afterward into the Trunk of the *Vena Cava*, and right Ventricle of the Heart.

If any be so curious as to make a search into the first formation of the Arteries, I humbly conceive they are produced after this manner; The Vital Liquor receiveth its first Rudiment in the Seminal Matter, wherein

The first pro-
duction of the
Arteries.

the most select part being Colliquated by heat, doth separate from the more gross, and not move promiscuously at large, but is confined within proper Channels which first take their progress toward the rough draught of the Heart, by whose motion it is impelled through the Retrograde Tubes, which are the first origins of the Arteries, as being produced out of the more clammy Particles of the Genital Matter concreted into Concave membranous Vessels, importing Vital Juice into the ambient parts of the Seminal Colliquated Liquor, to give it life and heat in order to the rough draught of the parts belonging to several Animals.

Arteries, as to their Figure, are Cylinders, having oblong, round, concave bodies fitted for the reception and transmission of Vital Liquor from the Center to the Circumference, from the Heart to the ambient parts of the Body.

The substance
of the Arteries.

Their substance is framed of numerous small nervous and membranous Filaments (interpersed with fleshy Fibres) closely conjoined to each other, produced originally out of the more tensil and clammy parts of the Seminal Liquor; These Fibres intersect each other in various postures, some being right, others oblique, and a third transverse. This Hypothesis of Fibres integrating this membranous Tube, may be proved, as I humbly conceive, by reason if the Vessels were made of one continued concreted substance, without the texture of various Filaments, their Coats would not be distended with a quantity of Blood, without Laceration; So that the numerous minute Filaments being tough and flexible, being of a firm pliable nature, can give way and grow swelled by a large proportion of Liquor immitted into this membranous system of Fibres, without any violation of their round minute Bodies.

The first Coat
of the Aorta.

The Compage of the *Aorta*, and its Branches, is composed of four Coats. The first and outward Tunicle is propagated from the *Pleura*, in the middle Apartment, and from the rim of the Belly in the lowest, and is destitute of it when it enters into the *Viscera*; This Coat is of a Nervous constitution, as integrated of many Nervous Fibres, finely spun, and curiously interwoven with each other, after the manner of Network, wrought in the inside.

The second
Coat of the
Aorta.

The second Coat of the Arteries is affixed to this retiform Tunicle, and is a Membrane beset with numerous minute Glands, overspreading its inward surface and is adorned in its upper side, with a retiform plex of divaricated Fibrils; this Tunicle, as I conceive, is propagated from the Coat (investing the Heart) to which it is continued.

The third
is endued
with many
fleshy Fibres.

The third Tunicle of the Arteries is more firm and thick, then the outward, especially in the common Trunk of the *Aorta*, conjoined to the left Ventricle of the Heart, that it might contain the hot spirituous thin blood immediately received from the left Ventricle without the dissipation of its Volatil Spirituous parts, and as the Arteries are more distant from the Center of the Body they grow more thin and soft.

This Coat is furnished with many transverse, or rather circular fleshy Fibres, which are very conspicuous in the common Trunk of the *Aorta*, relating to a great Beast. Learned *Rolfinchius*, conceived the substance of the Arteries to be wholly Membranous, as not having any fleshy Fibres; *Lib. 6. Anatomes, Cap. 4. Ait ille, nos statuimus substantiam Arteriarum esse suam, Membraneam, neque apte posse referri ad aliquam dictarum partium, sed esse propriam & sui generis, similitudine tamen Coloris & Crassitie emulari Cartilagine. Fibræ in hac Arteriarum substantia non dantur propriè dictæ;* but with

with deference to this worthy Author, I humbly conceive this Conjecture opposeth Autopsie, for we may easily discern the fleshy Fibres in the common Trunk of the *Aorta*, when boiled. Farthermore I apprehend that the fleshy Fibres of the Arteries may be clearly evinced by Reason, because if the Arteries were not beset with Carnous Fibres, when they are dilated by a great quantity of Blood in strong Pulsations, they would remain in the same distended posture, had they not a power to restore themselves to their former tone by the power of Fibres. And I farther believe, that the cause of an Aneurism, that when the second Coat of the Arteries, and its Fibres being broken, the Blood hath a recourse to the outward Tunicle, which being soft, is easily distended, whence ariseth oftentimes a large beating tumor.

The fourth Tunicle of the Arteries, as Great *Galen* hath observed, is as it were a thin membranous Tunicle, resembling a Spiders Web, which is visible to a curious Eye making inspection into the inward recesses of the great Artery, and seemeth to be the off-spring of the inward Tunicle investing the inside of the left Ventricle, as being a continuation of that thin Coat. This Tunicle is Membranous, as composed of many Fibres of the same kind, some of which being carried in length, do intersect the annular fleshy Fibres, according to right Angles.

The fourth Coat of the *Aorta*.

As to the substance of the Arteries, some hold it to be wholly Nervous, as being composed of many Fibres, which cannot be the sole off-spring of Nerves, by reason the Arteries are endued with little or no sense: Others conceive the Compage of the Arteries to be Cartilagineous, by reason many great Anatomists have found the Arteries near the Heart to be grissly and sometimes bony, but this is preternatural, and cannot be termed the true and proper substance of the Arteries, which is chiefly made up of many Membranous Fibres, endued with an obtuse sense, and these Fibres are peculiar to the Coats of the Arteries and Veins, and to no other Membranes relating to the Body.

Some hold the substance of Arteries to be wholly Nervous.

The Arteries seem to have a double motion, Diastole and Systole; The first, I humbly conceive, is produced by the systole of the Heart highly contracting the Ventricles, impelling the Blood out of the right Ventricle into the Pulmonary Artery, and out of the left into the common Trunk of the *Aorta*, and so into all Arteries; but the manner how the pulsation of the Arteries is made in all parts of the body in the same instant is hard to be understood; Learned Dr. *Harvey* expresseth it after this manner, That the pulsation of Arteries is performed by the impulse of the Blood, at the same time affecting all the Arteries, as when an immission of Breath is made into the great cavity of a Glove, at the same moment all the Fingers are distended; In *Lib. de Motu Cordis, Cap. 35. Ait ille, Deniq; Arteriarum Pulsus fieri ab impulsu sanguinis è Ventriculo sinistro, eo pacto, quo cum quis in Chirothecam inflat, omnes digitos simul videt distendi, & Pulsus æmulari*: To which I make bold, with the Great Author's leave, to speak this Reply, That the Simile of immission of Breath from the Hand to the Fingers, doth not hold by reason the distance is very small between them, so that the Breath may be immediately conveyed from one part to the other, which cannot be so easily effected in the motion of the Blood from the left Chamber of the Heart into the Extremities of the Arteries, which are seated at a great distance from each other.

The Arteries have a double motion, Systole and Diastole.

The manner of the Pulsation of the Arteries, according to Dr. *Harvey*.

Learned

Learned *Diemerbroeck* backeth this Hypothesis by a farther argument, That the Blood being hot and thin, as it is rarefied and easily moveable, and thereupon may be impelled from the Heart into the Arteries filled with Blood. *Ait ille, Anatomes Lib. 6. pag. 807, Sanguinem Arteriarum esse rarefactum, calidum, tennem, & hinc facile mobilem, eumq; e Corde impelli in Arterias simili sanguine antea repletas, unde pauxillum quid e Corde in Arteriam magnam propellitur, mox ab illo pauxillo etiam necessario totum, quod omnibus Arteriis inest, simul propelli, sicq; omnes Arterias eodem tempore simul distendi, si in Orbe stanneo, vel Scutella deponatur circulus Globulorum Contiguorum, & unus eorum manu promoveatur seu impellatur, ille proximum, alter tertium, & sic deinceps omnes eodem momento promoveantur & impelluntur, ita se habet in Arteriis, in quibus una parte sanguinis mota, moventur omnes.*

This famous Author Illustrates the Motion of the Blood in the pulsation of the Artery by the motion of many Bullets put into a Vessel, wherein one being moved, all do move; So that by this instance he concludeth that the Bullets move at once, which seemeth to contradict Reason and Sense, because though they be Contiguous, yet they press one another forward by a successive motion, and is done so quickly, as it seemeth to be but a moment, whereas in truth it supposeth more.

And in like manner the Blood is carried out of the left Ventricle of the Heart into the common Trunk of the *Aorta*, wherein it meeteth with a continued stream of Blood, which by degrees is moved by divers Channels into all parts of the Body, which cannot be effected any other way than by undulating Motion, by pressing one part of the Blood forward after another from the beginning to the Terminations of the Arteries; So that these Sanguiducts being propagated in many Flexures, by reason of their numerous Divarications, must necessarily give such a check to the over-hasty current of the Blood, that it cannot be impelled from the Heart at one moment through all the Arteries, which are seated at a great distance from the Center.

The manner
of the Pulsa-
tion of Arteries.

Whereupon I conceive, that the motion of the Blood out of the left Chamber of the Heart, making the Diastole (vulgarly thought) first in the common Trunk, and afterward in the ascendent and descendent Trunk of the *Aorta*, and divers crooked branches of the lesser Arteries, is not the cause of the pulsation of the Artery, which is performed in a moment in one brisk continued motion, and not successively by way of Undulation, which supposeth many Instants in which one part of the Artery is elevated after another, as it groweth distended by a great stream of Blood; So that I imagine the pulsation of the Arteries doth proceed from the vigorous contraction of the right and left Ventricle of the Heart, to which the Trunks of the Pulmonary and great Artery are affixed; whereupon their Trunks being briskly strook by the pulsation of the Heart, their continued Coats being ever distended with Vital Liquor, have the Vibration immediately imparted to them in all parts, after the manner of an Impulse made upon one part of an extended Musical string, the same stroke is immediately transmitted to every part of it, as the whole string is made up of one continued substance of a twisted Gut.

So that, I conceive, the Diastole of the Artery, taken in a strict notion, is not made by the successive motion of the Blood (first produced in the Heart, and then carried out of it, into the common Trunk, and afterward into the Arteries, furnishing all parts of the Body) but by the Systole of the Heart, first making a Vibration in it (which I have seen in a Dog dissected alive in the Colledg Theater) imparted in the same moment to all parts of the

the Arteries, which is the Pulse, commonly felt in the Wrist, and is at the same instant in all parts of the Body.

The Systole of the Arteries is their proper motion, as made solely in them by their peculiar power, without the assistance of the Heart, causing the Diastole, flowing from the vigorous motion, tension and contraction of the numerous strong fleshy Fibres of the Heart, but the Systole of the Arteries is a motion distinct from their Diastole, formed by the transverse or rather annular fleshy Fibres of the Arteries, whereby their cavity is narrowed, and the Blood pressed through their Channels with a greater quickness.

The Systole of the Arteries made by circular fleshy Fibres.

The contraction of these circular Fibres, causing the Systole of the Arteries, doth very much contribute to the motion of the Blood, flowing primarily from the Impulse, made in the Ventricles of the Heart by strong contracted fleshy Fibres lessening their Cavities; whereupon the Blood is squirted as by a Syringe out of the Right Chamber of the Heart into the Trunk of the Pulmonary Artery, and out of the Left into the *Aorta*, and then into all other parts of the Body, which is very much promoted by the motion of Carnous Fibres encircling Artery, else the Blood would have but a slow current upward through the ascendent Trunk of the *Aorta* and Carotide Arteries; and especially in the small Capillary Arteries of the Brain, in which the Blood would become stagnant, if its motion were not quickened by the Systole of the Arteries, produced by the Contraction of the fleshy circular Fibres.

The current of the Blood is hastened upward, especially in the Capillary Arteries of the Brain.

C H A P. XXXIII.

The Pathology of the Arteries.

The obstruction of Arteries coming from a grossness of Blood.

THe Arteries, being so many Cylinders, as oblong round concave Bodies, consisting of many Coats, are liable to many Diseases, some of which relate to their Cavities, and others to their Tunicles.

As to the Cavities of Arteries, their disaffections proceed chiefly, either from Obstruction or Compression; the first may be derived from the grossness of the Blood, stagnant in small Branches, or capillary Arterys, intercepting the current of the vital Liquor in these obstructed Channels.

The obstruction of the Arteries proceeding from a carnosus In-crescence.

The obstruction of greater Arteries may be produced by some carnosus substance, adhering to some parts of their inward Coats, and so clogging their Cavities, that they are rendered dis-serviceable, in order to the transmission of Blood from part to part.

The obstruction of the Arteries derived from concreted Chyme.

Sometimes the course of Blood is wholly hindered by gross concreted Chyme, mixed with Blood lodged in the pulmonary Artery, which I have often seen in Dissections of the heart (and Lungs) labouring with a Polypus, proceeding from a White gross coagulated Matter, stuffing up the Ventricles of the Heart, and pulmonary Vessels. Dr. *Timothy Clark*, a Fellow of the Colledge of Physicians, in *London*, and one of His Majesties Physicians in Ordinary, was afflicted with a high continued Fever, attended with a great Thirst and difficulty of Breathing, and a small quick Pulse, the forerunner of a fatal stroke. After which his Body being opened, the *Viscera* of the lower Venter, were ill affected with great Obstructions, and the Ventricles of the Heart being opened, were found filled with a thick White concreted Substance, which also stuffed up the pulmonary Artery, the immediate cause of his death.

Bleeding is good in obstruction of the Arteries.

The Cure of these Diseases, propagated from obstruction of Arteries, caused by gross concreted Blood and Chyme, may be effected by Blood-letting, and by aperient, Diuretick Medicines, mixed with well prepared Chalybeats, which do correct the gross clammyness of the depauperated Blood and Chyme, by rendring it Fluid, Volatil, and Spirituous, which hindreth its coagulation, by making it thin, and apt for Motion, as readily complying with the impulse of the Heart, made by the fleshy Fibres, contracting its Chambers.

The lessening the Cavity of the Arteries by Compression.

Another Disease to which the Arteries are incident in reference to their Cavities, may be deduced from Compression, whereby the bores of the Arteries are so much lessened, that they cannot freely, or not at all make good the circulation of the Blood, through the disaffected vessels, so that the neighbouring Arteries, sprouting out of the same Branch, do supply their defect, as having their Cavities free and open, which are dilated by the reception of a greater source of Blood, flowing into them, by reason the adjacent Channels belonging to the same Arterial Branch, were stopped up by the compression of an adjoining swelled part, which is frequent in Inflammations, or any other swellings of Muscular parts.

Bleeding good in the Inflammation of the Muscles

In this case often produced by Inflammation of Muscular, or Membranous parts, Bleeding may be very proper, by which the Tumor is lessened, and

and at last the compressed Artery set at liberty; gentle aperient, and cooling Apozemes, may be also very serviceable in these kind of swellings, as being accompanied with a Fever, and a hot distempered mass of Blood.

So much of the Diseases coming from the obstructed and compressed Cavities of the Arteries; I will now with your permission, Treat somewhat of Disaffections of the Coats relating to them, which may spring from Laceration, or Wounds affecting some or all of their Tunics.

An Aneurisme is much akin to these Diseases, as making a stop of the course of Blood, in a disaffected Artery, which doth not proceed (as Learned *Regius*, and *de Back* will have it) from the effusion of Blood, into the Interstices of the Vessels, whence ariseth a great Tumor of the fleshy parts; but from breaking of the inward Tunics of the Artery, and their annular Fibres, not being able to assist the Motion of the Blood by their Contraction; Whereupon the Blood not performing its due course through the Cavity of the Artery, doth stop and enlarge the outward Coat, whence often succeedeth a large beating Tumor, not derived as the Learned *Regius* imagineth, from a broken, or wounded Artery, who was courted into this Opinion by *de Back*; which is recounted by *Diemerbroeck* in lib. 6. *Anatomes de Arteriis*, Pag. 801. *In hanc opinionem deductus est Regius a Jacobo de Back, Medico Reterodamensi, qui ipse narravit casum viri in brachio vulnerati, cum lésione Arteriæ, in hoc aperto, & valde tumente brachio, dixerat se sanguinem Arteriosum inter Musculos copiosum, & pellicula conclusum invenisse. Ab hac unica narratione Regius mox artis fundamentum instituit, ac sibi hinc casum practicum effinxit, eumque, tanquam in suo aliquo agro sibi visum, suæ praxeos Medicæ, lib. 4. Medicam inseruit, & inde docuit, semper aneurismata tali modo generari (scilicet effusione sanguinis plane extra Arteriam) idq; quotidianam experientiam (qualem credo nec illum, nec alium quenquam hac de re unquam vidisse) docere & nugari, immo delirare eos dicit, qui putant Aneurisma fieri a Fibrarum, & ipsius media tunice lésione atq; exterioris extensione.* To which I make bold to give this Reply to the bitter and indisciete Language, in which he lesseneth his Esteem and Reason, which ought to be accompanied with courteous, soft words, which beget a good opinion in the Reader, and maketh way for an impression of his Sentiments in him, if they be not very extravagant, and contradictory to common Reason.

An Aneurisme.

An Aneurisme is a large beating Tumor.

An Aneurisme cannot come from extravasated Blood.

Again this Learned Author did not consider, when he affirmed an Aneurisme to flow from extravasated Blood, it would breed an Inflammation first, and then an Abscess, and not an Aneurisme, which is fetched from Blood, lodged in the Cavity of an Artery, whose inward Coats being broken, the outward is highly distended, sometimes productive of a large swelling, wherein a Pulsation may be plainly discovered, which sheweth the Tumor to be caused by a quantity of Blood, confined by a Coat within the Cavity of an Artery.

This Disease being a great Tumor of the Artery, springing from the Dilatation of the outward Coat, (made up by stagnant Blood, upon the Rupture of the inward Tunics) doth not denote the lessening of the Swelling by opening the outward Tunic of the Artery; whereupon a vent being given to the impetuous Motion of the confined Blood, it will let out the Life with a quantity of Spirituous vital Liquor. I conceive it more agreeable to Reason, to apply a Plate of Lead to the swelled part, or an Ointment of Bole, or redoubled linnen Cloaths, dipped in the juyce of Nightshade, or a Plaister against a Rupture, to keep down the Distention

An Aneurisme proceedeth from the Rupture of the inward Coat.

It is dangerous to open an Aneurisme.

Distention of the Artery, by corroborating the swelled Tunicle, and repelling the Blood inward, which giveth it Motion, and alleviates the swelling of the dilated Vessel.

Soluta unita
Arterie.

Another Disease relating to the coats of Arteries, is produced a *soluta tunicarum unitate* flowing from the piercing, or Laceration of the coat of the Artery; the First is made by wounding an Artery, which I have seen done by an imprudent Artist, not well versed in Chyrurgery, in opening the Artery of the Arm, with the Basilick Vein; whereupon the Arm grew very Black, as swelled with a great Exuberance of extravasated Blood.

The Laceration of the Arteries in great Contusions.

The Arteries are Lacerated by great Contusions in the Trunk and Limbs, whereupon ensueth a great proportion of Blood let out of the broken Arterial Branches, and lodg'd in the Interstices of the Vessels; Whereupon immediately ariseth an Inflammation of the bruised part, which may be cured by Emollient Discutient, and Anodyne Fomentations, Ointments, Cataplasmes, &c. In this Case Bleeding may be very proper, after an Emollient and Discutient Clyster hath been applyed, and then it is most safe to administer Topicks.

The great Pulsation of the Artery, coming from plenty, or thickness of Blood.

Another Disaffection (to which the Arteries, and principally those of the Head are incident, is a violent pulsation, which is found in Persons Hypochondriacal, and Historical, and proceedeth, (as I conceive) either from a vaprous mass of Blood, highly distending the Artery in the Diastole, as consisting of Elastick parts; or from a great exuberance of Blood, dilating the Coats of the Vessels, or from grossness of Blood, whereby the annular fleshy Fibres strongly contract the Artery, to make good the circulation of Blood, by impelling it through the small terminations of the Carotide capillaries into the Interstices of the Vessels, lodged in the Cortex and Medullary parts of the Brain.

An Instance of a violent Pulsation of the Artery.

An Instance of this case may be given in a worthy Gentleman, of a Plethorick Constitution, who was sensible of a great heaviness in his Head, caused by a fulness of Blood; as also of a violent Pulsation of the Artery (which he conceived to be inward in the Brain) derived from a gross mass of Blood, (appearing upon the opening of a Vein,) which was often repeated to lessen the exuberant mass of Blood.

The Cures of the beating of the Artery.

I also often advised Purgations, mixed with Antiscorbuticks, and Cephalicks; as also Chalybeat, Syrups, and Electuaries, and Waters made of Scorby-Grass, Water-creffes, of the tops of Pine and Firr, Millepedes, Nutmegs infused in Mumme, and after Distilled in it, and new Milk, which are often crowned with good success, as being very efficacious to attenuate and sweeten a foul mass of Blood, disaffected with gross Tartar, and many thick Filamentous Particles, and Filmes, which are much rectified by Antiscorbutick and Chalybeat methods of Physick.

CHAP.

C H A P. XXXIV.

Of the Veins relating to the Heart.

VEINS of the Heart are oblong, round, concave Vessels, importing Blood into the Right and Left Ventricles; and the venal Tubes are different from those of Arteries, because the first begin in Capillaries, and go on in Ramblers, and at last end in Trunks, and are inserted into the Right and Left Cistern of the Heart; and whereas the Arteries export Blood out of the Heart, and begin in the Heart in large Orifices, and great Trunks, and make their progress in less and less Channels, and do at last terminate into small Capillaries.

The Ventricles of the Heart are accommodated with the terminations of the *Cava*, and pulmonary Vein, the one being seated in the Right, and the other in the Left Side; and the Body, and surface of the Heart, is furnished with numerous divarications of the coronary Vein.

The Ventricles of the Heart are furnished with the Orifices of the *Cava*, and pulmonary Vein.

The small Capillar origins of Radication, and the lesser and greater Branches of Veins, relating to all the inward and outward parts of the whole Body (except those of the *Porta*) and pulmonary Veins, are implanted into the Ascendent or Descendent Trunk of the *Cava*, which are conjoined in one common Trunk, terminating into the Right Ventricle, into which, as a common Cistern, all the parts of the Body, except the Lungs, do discharge the numerous Rivulets of vital Liquor: on the confines of the Right Auricle, where the Ascendent espouseth a union with the Descendent Trunk of the *Cava*, being ready to discharge its vital streams into the Right Auricle, a Bunch or Prominence ariseth (which is worthy our remark) in the nature of a Dam, giving a check to the stream of Blood (passing in the descendent Trunk of the *Cava*) and turneth it into the Right Auricle, else the descendent leaning upon the ascendent Trunk, would hinder the current of Blood, passing upward toward the Heart; And by reason there is greater danger in a humane Body, placed in an erect posture, therefore Nature hath made this bunch, or prominence, greater in Man than other Animals, as Learned Dr. *Lower*, my worthy Colleague, hath most ingeniously discovered.

The Veins implanted in to the *Cava*.

A Prominence arising in the Right Auricle of the Heart.

And farthermore, lest the torrent of Blood being stopped in the adjoining *Cava*, by the contraction of the Right Auricle, therefore the *Vena Cava* about its termination (in greater Animals, as Man and Brutes) is encircled with annular fleshy Fibres, to give the *Vena Cava* strength to prevent a Laceration, when highly distended with a large torrent of Blood, whose Current is much hastened when the circumference of the *Cava*, is lessened by the contraction of these strong Fleshy Fibres; So that the vital stream is injected, as by a Syringe into the Right Auricle of the Heart; and in the *Vena Cava* of Horses, and other Beasts, these muscular Fibres are very large, and being strongly moved inward in a circular posture, do narrow the compass of the *Cava*, and squeeze the Blood with great force into the Cavity of the Right Auricle.

The annular fleshy Fibres of the *Cava*.

The small capillary extremities, and greater fruitful divarications of the pulmonary Vein, dispersed through the substance of the Lungs are all implanted

implanted into one Trunk, which emptieth the torrent of Blood by a large Orifice, into the Left Ventricle of the Heart.

The coronary Veins do shade the Heart with great variety of Branches, encircling the Base, and ascend toward the Cone; these Veins begin in most numerous minute Capillaries, and afterward are enlarged into greater and greater Branches, which are all implanted into one Trunk of the *Cava*.

The First production of Veins.

The Veins, (as I conceive) have their principle of Generation after this manner; the vital Liquor after it hath received its first Rudiment in the ambient parts of colligated seminal Liquor, doth separate it self from the other more gross viscid parts, which are concentered on every side of the vital Liquor into a round membranous Tube, in which the Blood is conveyed to the beating point; and afterward maketh its retrograde Motion from a rough draught of the Heart, not confusedly transmitted through the inward seminal Recesses, but is transmitted by other Tubes, formed on each side of the Blood, of the more gross genital juyce, coagulated by Heat into membranous Cylinders, conveying the gentle stream of Blood from the circumference of the melted Seminal Liquor; And it being granted that the parts of Blood being near akin, do espouse a confederacy in their first formation, and affecting Motion as their great preservation and complement, do by their heat and spirit, separate the more faculent adjacent parts of the seminal Liquor, which is coagulated on each side of the Blood, into round oblong Tunicles, through which, as so many Channels, the Blood is first conveyed by Veins from the circumference of the seminal Liquor, to the Center, and then from the beating point, the origen of the Heart, it is carried in by a retrograde Motion, by other Tubes, as Rudiments of Arteries, into the ambient parts of CrySTALLINE Liquor, in which the Plastick power doth reside, which is an efficient cause of the first production of all parts of the Body.

The substance of the Veins.

The Veins of the Heart are endued with a substance common to all veins of the whole Body, which is for the most part Membranous, as capable of Distention, without any Laceration, which else would happen, were they not accommodated with variety of membranous Fibrils.

The Coats of the Veins. The outward Coat.

The substance of the Veins is thinner then that of Arteries, and is made up of two Coats only, the outward may receive the appellative of Common, as taking its rise from the neighbouring parts, in the middle apartment from the *Pleura*, and in the lowest from the rimm of the Belly, and are not invested with this Coat, when they make their Ingress, and are branched through the substance of the *Viscera*; This Tunicle is framed of many small Fibrils, running in variety of positions, whereupon this outward Coat is receptive of Distention, without prejudice to its Compage.

The frame of the outward Coat of the Veins.

The inward Coat of the Veins made up of various Fibrils.

The Second Coat of the Veins may be stiled proper, which is its inward Tunicle, composed of threefold Fibres, rarely interwoven, of which some are right, others oblique, and a Third Transverse, and though this variety of Membranes can hardly be demonstrated by the evidence of Sense, as being so fine and close struck, that they elude the most quick Eye; yet they being considered by Reason, may be rendred manifest, as being wisely instituted by Nature, to conserve the due tone of the Veins, when much distended by an exuberant quantity of Blood, of which they being freed, have a power to reduce their Coats to their former Primitive, more easy posture.

Λεπτὴς ὡς μανὶς ἔστι ὁ ἁτὼν, *Tenuis & rara est hæc venarum tunica, teste Galeno, lib. 6. cap. 10. De usu partium. Hanc ut reliquarum partium similariū; Idem lib. 10. Methodi medendi, cap. 21. Seu ultimo, Ubi hanc venarum tunicam, membranosa*

Membranofam, Fibrofam, & Carnofam Conftituit. καὶ ἔκαστον γὰρ τῶν μυστρίων τῶν ἀπλῶν καὶ ποικίλων ὀνόμαζοντων ἐδιδότω καὶ τὰς ἀνατομίας. Τὸ γὰρ εἶδος ἰσώδες ἐστὶ καὶ ἰσῆς αὐτῶν τὸ δὲ ὕψος καὶ τὸ δὲ σαρκοῦς εἶδος εἰς τὴν φλέβαν ἔνα γένος κακτὴν δὲ λεπτόν ἐστιν εὐρεῖν καὶ αὐτῶν ἴσας πολλὰς δεχνομένης συναπτομένης. Αἱ ἀμφοτέραι, ἡ οἰκία καὶ φλέβος ἰσῆς ἀπετέφονεν. *In singulis simplicium ac primarum, quas vocant, partium (ut in dissectionibus es contemplatus) alia portio substantiæ est veluti Fibrosa, alia Membranosa, alia Carnosa; sicut exempli causa, cum vena unicam tunicam habeat, & eam tenuem, licet Fibras in ea inveniunt multas, quæ sunt araneosis quibusdam intersitis contextæ, quibus utrisque propria venæ substantia adnascitur.*

The inward Coats, according to Galen, is Membranous, Fibrous, and Carnous.

This Hypothesis of Great Galen may be plainly proved by Autopsy in the *Vena Cava*, of large Animals adjoining to the Right Side of the Heart; and I humbly conceive, that other parts of the Trunk, and branches of the *Cava* are beset with fleshy Fibres too, which are much smaller in those places, then about the termination of the *Vena Cava*, whereupon they are not so easily seen.

The fleshy Fibres of the *Cava*.

And I humbly conceive the annular fleshy Fibres, encircling the Tunics of the Veins, are of a very important, if not necessary use, to further the circulation of Blood, which else would be very slow in the Veins, were they not assisted with circular fleshy Fibres, which contracting themselves, do very much promote the motion of the Blood in all Veins, and more particularly, its ascent in the ascendent Trunk of the *Cava*, toward the Right Ventricle of the Heart.

The use of the fleshy Fibres of the Veins.

And this Hypothesis may be farther confirmed, that the fleshy Fibres are of great importance to give vigor and strength to the coats of the Veins, which being highly dilated by great torrents of Blood, or by a quantity of gross vital Liquor, have their inward coat broken with its annular Fibres, so that it groweth so relaxed, that it cannot contract it self, by reason the Fibres are lacerated, which is very conspicuous in *varicibus venarum, a Fibris circularibus disruptis, provenientibus*.

The Veins have many Valves affixed to their inward Concave Surface, and are framed of a thin compacted membranous substance, derived (as I apprehend) from the interior Tunicle of the Veins.

The Valves of the Veins.

They are adorned with a semilunary Figure, and are for the most part single, and sometimes double, and sometimes treble, as some conceive, seated against each other, which are found only in the great Veins of large Animals: Some Anatomists have discovered Three Valves, seated opposite to each other in a triangular Figure.

The Figure of the Valves.

The set number of the Valves seated in the inside of the Veins, cannot be recounted, by reason the eminent Valves, placed in the great Veins, can only be discerned, and the infinite number of minute Valves, besetting the small Veins, can no ways be discovered, but it is very clear to Reason, that there be such Valves, which are consigned to a great use, to give a check to the retrograde motion of the Blood toward their Origins, which else would destroy its circuit toward the Heart, which is absolutely necessary to preserve the choice vital Flame.

The number of the Valves cannot be counted.

And seeing the Veins and Arteries are both Channels, importing and exporting rivulets of Blood, to and from the Heart; it may be worth our consideration, to assign the Vessels, in which the motion of the Blood is commenced, and carried to the Heart, as the great machine of Motion, which I humbly conceive is first performed in the Veins, by reason they have their first rudiment in the seminal Liquor, before the Arteries were formed, because the Veins first received the Blood, formed originally in the ambient parts of the colli-

The motion of the Blood is first made in the Veins.

quated

quated Seed, and so conveyed it to the beating point, and afterward the Arteries were framed to make good the retrograde Motion of the Blood, began in the Heart, and carried on to the circumference of the genital matter. And as many small Rivulets of Water begin in little Ducts, and afterward meet in the large channel of a River, conveying a great torrent of Water; so in like manner the minute streams of Blood begin their Motion in numerous capillary Veins, and are afterward transmitted through greater and greater Branches and Trunks, till they arrive to the greater Cistern, seated in the Right Ventricle of the Heart.

CHAP. XXXV.

The Pathology of the Veins, and its Cures.

THE Veins being the associates of the Arteries, are near akin to them as they are, both Channels transmitting Blood from part to part, and both much alike in Figure, as they are both Cylinders, endued with oblong, round, concave Bodies; whereupon these different Ducts are much related to each in affinity of Diseases, and the Veins as well as Arteries are disaffected with Obstruction, Compression, Laceration, and Varices too, which is a Disease peculiar to the Veins: and as being a swelling (arising from stagnant Blood) hath some little Analogy with that of an Aneurisme.

The obstruction of the Veins arising from Blood.

An obstruction of the Veins, making a more general unnatural distention, then that of the Varices (which make particular swellings, especially in the smaller Branches) doth arise from the grossness or quantity of Blood dilating the Veins, which happeneth mostly in the ascendent Branches of the *Cava*, wherein the weight of the Blood much hindreth its ascent toward the Right Auricle and Ventricle of the Heart; whereupon its pulse groweth faint and languid upon the defect of a due proportion of Blood to give spirits to, and fill the Pores of the fleshy Fibres, with its warm juyce.

Bleeding is proper in the obstruction of the Veins, and Purgatives, are proper in a grossness of Blood.

The Cure of this Disease in reference to a quantity of Blood, obstructing the Cavity of the Veins, doth indicate the opening of a Vein with a large Orifice, and a free mission of Purple Juyce.

In relation to this Dilatation of the Veins, caused by grossness of a Fæculent Blood, Purging Medicines, accompanied with antiscorbutick Apozemes, and Chalybeat Tinctures, Syrups, Powders, (given in a fit Menstruum) are very proper to attenuate and refine the thick dispirited mass of Blood, disaffected with a melancholick Constitution.

Obstructions of the Veins coming from a crude Chyme mixed with Blood

An obstruction of the Veins may proceed also from a crude Chyme, obstructing them, in which it is sometimes concentered, which I have seen in the pulmonary Vein, obstructed with a White coagulated substance, wholly intercepting the Current of Blood in the Lungs, toward the Left Ventricle of the Heart.

This Disaffection may be cured before it cometh to a height, by prescribing a thin Diet of easy digestion, which maketh a well concocted Chyle, and attenuateth

attenuateth the mass of Blood, which is effected also by purging Antiscorbutick, Diuretick, and Chalybeat Medicines, refining the Blood, and preparing good Ferments for the Stomach, consisting in the more mild Particles of the Blood, and good nervous Liquor, associated in the glandulous Coat of the Stomach, and conveyed into its Cavity by proper Ducts, or Pores.

Another Disease of the Veins cometh by their Compression, whereby their Cavities are lessened by the neighbouring parts, which frequently happeneth in very corpulent persons, whose lumps of Fat adjoyning to the Veins do highly retard the motion of the Blood, rendring the pulsation of the Heart very slow; whereupon all the Body becometh Languid, by want of a due supplement of vital Liquor. A gross habit of Body, surcharged with over much Fat, as lessened by spare Diet, and constant exercise, and proper Purgatives, and Diet-drinks, which give an allay to the excessive oily Particles of the Blood, the *Materia Substrata* of Fat, which are extravasated sulphureous Atomes of vital Liquor, concreted in proper Receptacles.

The Compression of the Veins.

Another Disease denoting Bleeding, (to which the Veins are incident by Compression) may be deduced from the tumors of adjacent parts to the Veins, as from the inflammation of the Musculous *Psoas*, which bordering upon the ascendent Trunk of the *Vena Cava*, doth narrow its Cavity, and hinder the free recourse of the Blood to the Heart, in like manner all Inflammations of the *Viscera*, do hinder in some degree or other, the reflux of Blood toward the Center.

The Compression of the Veins derived from the Tumor of the adjacent parts, which is much alleviated, if not cured, by Bleeding.

This Disease denoteth Bleeding, (as it floweth from a quantity of Blood settled in the Interstices of the Vessels,) by reason the opening a Vein, doth lessen the quantity of Blood, and diverteth the course of it from the part affected; whereupon it is most readily relieved, by taking away the Tumor; so that the neighbouring Veins are freed from Compression, and regain their proper use and liberty of transmitting Blood toward the Heart.

A Disaffection of this kind may proceed from the great distention of the Womb (caused by a great *Fetus*) compressing the Iliack Branches, and the ascendent Trunk of the *Vena Cava*, whereby the ascent of the Blood toward the Center is very much hindered, producing a languid Pulse in the Heart and Arteries.

A Compression of the Iliack Veins, and the ascendent Trunk of the *Cava* in the time of Gestation. The cause of the Tumors, called *Varices Venarum*.

And on the other side, the Veins are not lessened only by the Compression of the adjacent parts; but dilated too by a gross mass of Blood, making Varices, to which the Veins of the *Tibiae* are very much incident, whence Knots and Tumors arise in small Veins, from a quantity of Fæulent Blood, stagnant in some parts of the Veins; whereupon they grow sometimes very much distended from the Knee to the Ankle-bone, which giveth a great discomposure in walking.

In this case a straight Stockin may be used, and astringent Plaisters prescribed, and in some Varices, the Tumors may be opened, after Ligatures have been above and below the swellings, and proper Medicines, endued with astringent qualities, may be applied; As Learned *Paræus* hath advised in *Lib. 12. De Ulceribus, Fistulis, &c. Cap. 20. P. 390.*

Cum multi Varices & varie impliciti in crucibus existunt, thromboso sæpe & resiccato sanguine tument, doloremque faciunt, qui incessu, & Compressione exacerbatur. Eiusdem Varices scalpello divisa vena aperiendi sunt, & Compressione sursum, deorsumque facta sanguis ille exprimendus atque vacuandus. And addeth afterward at the end of the Chapter, *Peracto opere, (vid.*

incisione varicis) adstringens medicamentum vulneri vicinisq; partibus imponitur: neque nisi exacto triduo, circa vulnus quicquam movetur. Cætera deinde, quæ reliquis communia sunt, peraguntur.

Tumors in the Body derived from the laceration of Veins.

Tumors also arise in many parts of the Body, as in the Membranes, Muscles, and Viscera, produced from a large quantity of Blood, flowing from the laceration of Veins upon great Contusions; in this case a Vein is proper to be opened, and a quantity of Blood let out, to divert the current of Blood from the swelled bruised part.

Inflammations proceeding from a quantity of blood coming from the obstructed Origins of the Veins, in which case Bleeding is good.

Inflammations also proceed from a large proportion, or the grossness of extravasated Blood, lodged in the substance of the solid parts; whereupon they grow distended, by reason the Origins of the Veins, are either obstructed by some crass Matter, or as too small to give reception to the thick melancholick Purple Liquor.

In this case also Bleeding freely is very good and safe, and afterward cooling Juleps to contemper the hot mass of Blood, and take away the Symptomick Fever, which is an attendant of Inflammations; and I am here very concise in the Cure of this Disease, because I have advised in it more largely heretofore.

CHAP.

C H A P. XXXVI.

Of the Blood-Vessels of other Animals.

THE Blood-Vessels of other perfect Animals hold great Analogy with those of Man, both above the Heart in the ascendent Trunk of the *Aorta*, and its great Branches of Subclavian, Axillary, and Carotide Arteries of the Brain; and also in their Associates, the descendent Trunk of the *Vena Cava*, the Subclavian, Axillary, and Jugular Veins, answering the Carotide Arteries of the Brain.

And not only the Sanguiducts of other Animals observe a great likeness with those of Man, above the Heart, but below it too, in the descendent Trunk of the great Artery, and the ascendent Trunk of the *Vena Cava*, and their Intercoastal, Phrenick, Mesenterick, Emulgent, Spermatick, Iliack, Hypogastrick, Crural Branches of Arteries and Veins.

In Fish, the pulmonary Arteries and Veins are deficient, and are supplied with numerous Branches, and divarications of the Blood-vessels, seated in the Gills, which are substituted by Nature, for the passage and refinement of the Blood instead of the Lungs: In Fish the Subclavian, Axillary, and the Crural Arteries and Veins, are wanting, by reason they are destitute of Lungs.

In Insects these Arteries and Veins are not only deficient, but the Splenick, Hepatick, and Emulgent Arteries; And these minute Animals are accommodated with less variety of Blood-vessels, as having small Trunks, and less Divarications, more minute Branches running through the Heart, Stomach, Intestines, Genitals of both kinds, below, and through the Brain above.

The Heart in Insects, as well as other more perfect Animals, doth impell Blood through the Arterial Trunks and Branches, into all parts of the Body, which is afterward received into the extremities of the Veins, and brought back again to the Heart; so that their gentle flame of Life is as well preserved in them by motion, as in greater Animals.

And I humbly conceive that in these fine Epitomes of Animals, the great variety of minute Branches dispersed to all parts of the Body, do impart vital Liquor to each other, by many inosculation's curiously made after the manner of Network, as it is in other Animals.

The vital Liquor exported and imported from, and to the Heart by various Cylinders in Insects, is arrayed in White or Yellow, and not in Scarlet or Purple, as in other Animals, by reason those deeper colours are not belonging to the Essence of Blood, which is white in them too in its first production in the skirts of the seminal Liquor, from whence it beginneth its Motion toward the beating point, and by degrees, when it obtaineth greater perfection by motion, it quitteth its White or Yellow array, and putteth on its Scarlet or Purple Robe.

The Blood-Vessels of perfect Animals are very like those of Man.

The pulmonary Vessels are wanting in Fish, and are supplied with the Sanguiducts of the Gills.

The Insects have many Blood-Vessels wanting, which are found in more perfect Animals.

The motion of the Blood through the Heart, into the Arteries and Veins of Insects.

The Blood-Vessels of Insects are indued with inosculation's after the manner of Network.

C H A P. XXXVII.

The Sap-Vessels of Plants.

The various Tubes of Plants, are somewhat alike to the *Viscera* of Animals.

Plants are furnished with many sorts of Vessels.

The Figure of the Sap-Vessels,

The greater Sap-Vessels are beset with many small Pipes.

The Divariations of the Sap-Vessels do somewhat resemble the Divariation of the Sanguiducts. The progress of the Sap-Vessels, is for the most part perpendicular, and sometimes horizontal.

The Vessels of Plants agree in some sort with those of Animals, as containing many Liquors.

THe various Tubes entring into the Compage of Plants, are somewhat akin in likeness to the *Viscera* of other Animals (which are more distinct in them) as they are curious Systemes, integrated of innumerable oblong round Vessels, as so many Cylindrical Channels, chiefly constituting the fine frame of Plants.

The Antients not well versed in the knowledge of the several parts belonging to Trees, have treated of them in a more general notion of Wood and Bark, which in truth may be more clearly distinguished into Veins or Vessels, as various lacteal, Gummy and Resinous Channels, transmitting divers Liquors into the Trunks and Branches of Plants, which do somewhat resemble the several Vessels of Animals, conveying Chyle, Vital, Nervous, and Lymphatick Liquor; so that the milky humor resembleth the Chyle, and the Sap the Blood, and their Resinous and Gummy Juices being transparent, do in some manner represent the Nervous and Lymphatick Juice.

And these different Liquors do not only hold Analogy with those of Animals, but their Vessels too in structure, (as they are Cylinders adorned with a round oblong Figure) made up of numerous Fibres rarely interwoven with each other.

In Trees the greater Cylinders are beset with many minute Pipes, which confining close to them in an orbicular Figure, do make use of the sides of the larger Tubes; so that every part of a Tree is integrated of various ranks of greater and less concave Fibres, resembling the larger and smaller Branches of Vessels in Animals.

And the various Ducts of several Liquors in Plants and Trees, do not only in some sort resemble the Vessels of a humane Body in Figure, but in Divariation too; because the ascendent and descendent Trunks of Arteries and Veins, as well as Sap-Vessels, take their progress the whole length of the Body; and as Animals have fruitful Branches running horizontally from their Trunks into the Muscular parts, and substance of the *Viscera*; So in like manner in Plants and Trees, the cortical Branches of Vessels are carried transversely from the Bark through the body of the Trunk toward the Pith, and from it too many lignous Vessels are propagated through the Compage of the Wood to the Bark.

And as the *Viscera* of Animals are collective Bodies of different Vessel as Arteries, Veins, Nerves, and Lympheducts, as so many Channels, conveying several Liquors of Blood, *Succus Nervosus* & *Lympha*; so after some manner the Trunks and Branches of Firre, and Pine-tree, &c. are alike the *Viscera* of Animals in their various Tubes, fraught with Gumms, Resine, interspersed with Vessels of Sap, which for the most part run perpendicularly from the Root, through the Trunk to the top, and some of those Vessels pass Horizontally, as so many Diametral Rays from the Bark through the Body to the Pith, and others from it to the Bark, from the

the circumference to the Center, so that these transverse Vessels have a semblance with the Veins and Arteries of Animals, which take their progress from the Skin, through the Trunk and Limbs to the inward Recesses of the *Viscera*.

The curious frame of Plants are made up of different Cylinders, finely set together, and Engraven with numerous Cells (adorned with several shapes and sizes, placed between the Sap-vessels) as so many little Cisterns, supplying the Vessels with different Liquors, exalted by airy Particles, (impregnated with sulphureous and saline Atomes) transmitted by proper Cylinders into the Concave *Area*, big with alimentary Juices, which after a due Fermentation, are refined by the extremities of numerous different Sap-Vessels, as so many Colatories (of various Figures and Magnitudes,) holding Analogy in some manner with the minute Glands of the *Viscera*, which are Systemes composed of numerous Vessels, whose Extremities are distinguished by their various Perforations,, receptive of such Liquors, as hold Conformity with them in the likeness of Shape and Size.

Between the Sap-Vessels are seated many *Area*s, as so many Cisterns, of different Liquor.

C H A P. XXVIII.

Of the Lungs.

HAVING Treated of the Diaphragme as the Floor, and of the *Pleura* as the Hanging, and of the Mediastine as the Party-Wall, and the Heart as a noble Utensil of the middle apartment: my aim at this time is to discourse of the Lungs, as part of its choice Householdstuff, which is a Machine of Air, composed of variety of rare parts.

This excellent Utensil of the middle Story, relating to the elegant Fa-
brick of Man's Body, may be considered according to its Situation, Connexion, Figure, Membranous Substance, Vessels, Glands and Use.

The Situation
of the Lungs.

The Lungs are seated near the Heart, which it encircleth with Lobes, as with so many wings fanning this hot Engine of Motion, and it filleth up the two Chambers of the middle apartment, except that part of them possessed with the *Pleura*, Mediastine and Heart.

The Lobes of
the Lungs
are parted by
the media-
stine.

This curious Engine of Air is divided into two Regions, parted by the Mediastine, the one placed in the Right, and the other in the Left Chamber of the middle Story, and each part consisteth of two Lobes, the Superior and Inferior, as Partitions, wisely ordered by Nature, that when one Lobe is wounded or corrupted, the other may be preserved.

The Lobes of
the Lungs
have a mutual
entercourse
by Vessels.

The rare structure of the divided Lobes are mutually conjoyned by Membranes, and have entercourse with each other, by the union of variety of Vessels, importing and exporting different kinds of Liquors.

The Connexion
of the
Lungs.

The Right and Left partitions of Lobes are severed from each other by the mediation of the Mediastine (as by a middle Wall passing between them) by whose help they are connected in their fore parts to the Sternon, and in their hinder to the Vertebres of the Back, below to the Midriff, and above to the Neck and Back, by the interposition of the Wind-pipe. Learned *Spigelius* conceiveth the Lungs to be tied to the *Pleura* and Ribs, by Fibres, which being short, saith the worthy Author, they produce an incurable difficulty of Breathing; but with the permission of this skilful Anatomist (I humbly conceive) these Fibres are very rare and preternatural, as proceeding either from an ill conformation in the Womb, or from some Disease; and if these Fibres were natural, they might be discerned in all Men upon Dissection, which contradicteth Autopsy.

The Figure of
the Lungs.

The Figure of the Lungs do conform themselves to that of the Thorax, and have their upper ambient parts invested with a convex Surface, as lodged within the circular Walls of the Ribs, and the lower Surface of the Lobes is Concave, as fitted to receive the Heart within their soft embraces.

The two
Lobes resemble
the hoofs
of a Bullocks
Foot.

The two Lobes seated in each Chamber of the middle apartment, may be most fitly resembled to a Heart or Bullocks Hoof, consisting of two Claws, parted all along in the middle, and begin in more large, and end in more narrow Dimensions; and also are covered in their upper region with a Convex, and in their lower, with a Concave Surface.

The Mem-
brane of the
Lungs.

The ambient parts of the Lungs are coated with a thin Porous Membrane, borrowing its Origen, as some will have it, from the *Pleura*, and as others, from the out ward Tunicle of the Vessels, entring into the substance of the Lungs.

The

This Membrane is beset with many Pores (which may be seen, when the Lungs are blown up with a pair of Bellows) and are so minute, that they hold no proportion in Figure, and magnitude with the Particles of Air, contained within the substance of the Lungs, or else they would soon transpire the Pores of the Membrane encompassing the Lungs, before it had sufficiently impregnated the Blood with its Nitrous and Elastick Particles, conserving the vestal flame of Life.

Learned *Diemerbroeck* asserteth, that though Pus cannot be received through the Pores (pinking the Coat) into the substance of the Lungs, yet he saith, thin Liquors injected through the wound (made between the Ribs) in case of an *Empyema*, into the Cavity of the Thorax, may insinuate themselves through the secret *Meatus* of the Tunicle (encircling the Lungs) into their inward Recesses, and Bronchia, and thence into the Mouth, as the renowned Author hath it in *lib. 2. Cap. 13. de Pulmo. & respirat. Pag. 511.*

Ait ille, Memini me Noviomagi sex septemve Empyricis ad puris evacuationem Thoracem inter Costas sectione aperuisse, ac denique evacuato pure nonnullis eorum injectiones abstergentes amaras in Thoracis Cavitate infudisse, quarum non tantum amarum saporem ore perceperunt (quod etiam a Fernelio, Paræo, Lommio, & aliis observatum) verum bonam quoque partem per sputa rejecerunt, quod certum judicium erat, in illis ægre poros tunice pulmonis adeo angustos fuisse, ut nullum Pus crassius, sed duntaxat tenuiores liquores admittere potuerint.

Hypocrates the great Oracle of our Art asserted the substance of the Lungs to be glutinous, and full of Cells, and numerous Blood-Vessels, as he hath it *Sectione Tertia, lib. de carnibus*; his words are these in the Original:

*Hypocrates's
Opinion of
the structure
of the Lungs.*

ὁ δὲ πνέμων ὡς τῇ καρδίᾳ ἐξέτερον ὡς δὲ, τὸ ὕψος ὁμοῦν ἢ κολλωδέστατον ἢ καρδίᾳ περιέχοντα, τὰ δὲ ἐξήγεγεν
ἔκτος περὶ ἀφρον, καὶ ἐπὶ πίνον οὐραγῶδες καὶ φλέβια πολλὰ ἐν αὐτῷ.

Pulmo atem juxta Cor sic extitit; quod in humido glutinosissimum erat, Cor calefaciens, celeriter exsicavit, veluti spumam, & Fistulosum reddidit, multisq; venulis resperfit. I conceive the moist clammy seminal Matter, according to *Hypocrates*, is concreted by heat into a loose spongy substance of the Lungs, which this great Author calleth Froth, as Boys raise Bubbles out of Water, impregnated with some fatty substance, which are watry Vesicles filled with Air; so that the soft frothy Parenchyma of the Lungs, is nothing else but a spongy Systeme of many Vesicles of Air (without any effusion of Blood, as the Antients imagined) which *Cicero* seemeth to assert *2. Natura Deorum, raritas pulmonis celebratur, & assiduis spongiis mollitudo ad-hauriendum spiritum aptissima.* This great Philosopher as well as Orator conceived the Lungs to be a loose Compage, made up of Sponges, which are loose Bodies furnished with numerous Cells, the Receptacles of Air, which much resembleth the Vesicles, chiefly constituting the spongy body of the Lungs, often filled, and emptied by the many repeated Expansions, and Contractions of the Lungs, celebrated in inspiration, and expiration, the one being assisted by the Midriff and Intercoastal, and the other by the Abdominal Muscles.

*Cicero's
his
Opinion of
the Lungs.*

Ingenious *Malpighius* hath given a greater Light to the more intricate and obscure Opinion of *Hypocrates*, who left us much in the dark, in reference to the curious structure of the Lungs, whose substance is integrated of parts, Air-pipes made up of Cylinders and Orbs; as also Sanguiducts and Lympheducts.

*Malpighius's
Sentiments of
the frame of
variety of
the Lungs.*

The Cylinders of Air are branched through the whole body of the Lungs, in many Divarications, highly dilated in inspiration.

*The branches
of the Wind
pipe.*

These

The Vesicles
of Air appen-
dant to the
branches of
the Trachea.

These oblong Tubes have many Membranous appendages, affixed to them as so many Outlets and Receptacles of Air, which being big with it, do very much enlarge its Perimeter.

The seat of
the Vesicles
of Air.

That I may give a more full History of these Membranous Cells, relating to the Lungs as a Machine of Air; I will Treat of their Situation, Connexion, Figure, Origen, Termination, Substance, and Use.

These fine Cells are seated every way near the Bronchia, as so many appendants of them, and every Cell hath a double passage, an Egress from, and Ingress into the Bronchia, to give the Air a free play in and out upon inspiration and expiration.

The connexi-
on of the Ve-
sicles of Air.

These Membranes or Orbs of Air are connected to the sides of the Bronchia, as being a part of them, in reference to their continued inward Membranes, and do participate the same structure.

The orbicular
Figure of the
membranous
Cells.

They are adorned for the most part with an orbicular Figure, as being the best and most capacious, wisely instituted by Nature (as I conceive) for the greater reception of Air in inspiration, and the more easy exclusion of it in expiration.

The Origen
of these Cells.

These fine round Machines of Air take their Origen from the inward coat of the Bronchia, as being alike in Substance, Texture, and Use.

So that these round Cells, or membranous Expansions take their rise from the inward Recesses of Air-Tubes, and are propagated through the whole substance of the Lungs, and at last terminate into the Coat, investing the ambient parts of the Lungs.

The substance
of the Vesicles
of Air.

The substance of these Orbs, which constitute a considerable part of the Lungs, are chiefly Membranous, and are a fine contexture made up of numerous Fibrils, passing in various Right, oblique, and transverse Positions, which give strength to these thin Expansions, which would be lacerated when distended with Air, were they not framed of many Fibres, made in different postures, close struck, and curiously interwoven with each other.

The Vesicles
of Air are en-
dued with
fleshy Fibres

These receptacles of Air are not only endued with membranous Fibres, but fleshy too, which being annular, as those of the Bronchia, are derived from them, and have a power of contracting these Cells, to squeeze out the Air in expiration, and throw the gross Chymous, or phlegmatick Matter lodged in them into the Bronchia, in Coughing, and afterward into the Wind-pipe, and Mouth.

The use of the
membranous
Cells, accord-
ing to *des*
Cartes.

Ingenious *Des Cartes* conceiveth these Vesicles of Air, according to their variety of Figure, to be consigned to a double use, the one to retain the inspired Air, and the other to expell it; These sentiments of this Learned Author, are more witty then profound, by reason both the Bronchia, and these appendant Cells of Air are constituted by Nature, First to be Receptive, and after to be Expulsive of Air, and not to have a distinct Office, at the same time to be some of them Repositories of Air, and others to throw it out in expiration.

The pulmo-
nary Artery.

The Pulmonary Artery springing out of the Right Ventricle of the Heart, and inclining toward the Bronchia, is divided into a Right and Left Trunk, out of which do sprout on both sides, an innumerable company of minute Bronchia (making numerous inosculation) Associates of the divarications of the Bronchia, and are afterward dispersed into the Lobules of the Lungs, and being also companions of the Bronchial Artery, and pulmonary Veins, do often touch each others Coats; and making great Complications, do at last encircl

encircle the small orbicular Vesicles, and shading them with a fine Network, do swath their circumference to enliven and corroborate their fine Compage.

The pulmonary Vein borroweth its rise from the substance of the Lungs in small Capillaries, encompassing the Vesicles of Air, belonging to the Bronchia, with fruitful Ramulets (accompanying the Arterial Divarications) which often uniting, and parting again after a small distance, do make a kind of reticular Plexes, or Masshes; these pulmonary Veins do answer those of the Arteries, almost in number and order, and do much contribute to the fine contexture of small Vessels, with which the orbicular Cells are enamelled.

The pulmonary Vein.

And the substance of the Lungs is not only framed of numerous Divarications of Arteries and Veins, but of Nerves too, which do take their Origen from the *Par Vagum*, or eight pair of Nerves, and are propagated, not only into the outward Membrane, enwrapping the exterior parts of the Lungs; but are also distributed into the body of the Lungs, and do also associate with the pulmonary Artery and Vein, when they make their Divarications over the surface, and over the orbicular vesicles of Air.

The Nerves of the Lungs.

The Lympheducts of the Lungs are small Tubes, clothed with most fine Diaphanous Tunicles, which are affixed with minute Membranes to the Coats of the pulmonary Vein, and then tend to the inward recesses of the Lungs, and after pass out of them, and are at last inserted into the common Thoracick Channel, into which they discharge their Lympha, the recrement of the Blood, (separated from it in the substance of the Glands which are very numerous in the Lungs) and is afterward conveyed into the extremity of the Lympheducts.

The Lympheducts of the Lungs.

If a greater inspection and deeper search be made into the substance of the Lungs, the Compage of them may be discovered to be in part composed of numerous Lobules, of which every one is immured within a proper Membrane, distinguishing them from each other, by several thin Walls, as so many different boundaries.

These small Lobes of the Lungs, are endued with divers kinds of Blood-vessels, furnishing them with many Divarications, accompanying the branches of the Bronchia.

The Lobules may be discerned, if the Lungs be blown up, and held up against the Light, whereby some transparent Interstices may be discovered (according to most ingenious *Malpighius* his observation) whereupon a gentle incision being made, and by tracing the Interstices, the Lobules may be found adhering to the sides of the Bronchia, and Blood-vessels, from which they may be severed with a tender touch, and may be seen to be invested with proper Tunicles; and in truth are nothing else (as I humbly conceive) but many Systemes of various Vessels, confined within peculiar Coats, for the better security of the numerous minute Vessels (branched through the body of these Lobules) and to keep them in a due order, for the better circulation of the Blood.

The Figure of these Lobules is in some sort Conical, as having greater dimensions in the middle, and ending into an obtuse Cone, resembling somewhat of a Cypress Nut.

And it will be difficult to describe the Situation, Origen, and Insertion of the Lobules, by reason they are branched with the appendant vessels on every side of the Bronchia, after the manner of the branches sprouting out of the trunk of a Tree; and these ramifications, are terminated into the outward surface of the Lungs, which ought to be plain and equal; and sometimes

times these Lobules are affixed to the extream Angles of the adjoining Branches, that their due Situation, Union, and Connexion may be preserved; whereupon these Lobules are seated sometimes in the lower Region of the Windpipe, and other times in the sides or extreme parts of it.

Next to the Lobules, their Interstices present themselves, as the subject of our Discourse, which are not meerly empty *Areae*, but are endued with extended Membranes, sometimes parallel to themselves, and sometimes angular, which are not propagated from the ambient parts of the Lobules (seated on their sides) but from their more inward Recesses: And between these Membranes, filling up the vacuities of the Lobules, many minute Blood-vessels do run, and are derived from some, and are implanted into the adjoining Lobules: Into these Membranes interceding them, the Air is received as into more large *Sinus*, which have a mutual entercourse, that the received Air out of one Cell, may be ejected into another by Compression; so that these Interstices, interspersing the Lobules, are nothing else but the membranous Vesicles of Air, rendring the *Areae* transparent.

These Interstices distinguishing the Lobules from each other, are most conspicuous in great Animals, and do equal in Dimension half a Fingers breadth, and are conducive to the distinction, and connexion of the Lobules, by whose interposition they are united; and when these Interstices, or membranous Cells are distended with Air, they do straighten the adjacent Lobules, and assist the mixture of the Blood with the Chyme.

In these Interstices seated between the Lobules, in diseased Lungs, may be discerned the Hydatides, which are the membranous Cells filled with watry Recrements, instead of Air, which produceth a difficulty of breathing.

And if any scrupulous persons be not fully satisfied, that there are any such Lobules, or Membranous *Sinus* interceding them, I would advise them for their better satisfaction, to view the Lungs of divers Animals (newly killed) while they are warm, and then with Glasses, if not with a naked Eye, may be discovered a multitude of small orbicular Vesicles distended with Air, and may be farther discerned in the emptied Lungs, cut through the middle, which then are less conspicuous, and may be better seen in Lungs blown up and dried, by reason the round membranous *Sinus* may be clearly discerned in the outward surface of the Lungs, and in the Dissecting of them, may be clearly viewed the off-spring of numerous hollow Membranes, distended with Air.

And this Hypothesis of Lobules, and their *Areae*, garnished with orbicular Vesicles, may be proved by injecting water again and again, into the pulmonary Artery, whereby the Blood is dislodged, and the Sanguinoducts washed clear, so that the whole substance of the Lungs may be rendered whitish, and almost transparent, as divested of its opake Scarlet Robe.

And when the Lungs are sufficiently washed from the stagnant Blood, the Water may be ejected by a gentle Compression, and after a quantity of Air being immitted by a Blow-pipe into the body of the *Aspera*, and its numerous smaller Pipes, and the Lungs dried in the Shadow or Sun, you may plainly see, not only the round transparent Vesicles, seated in the circumference of the Lungs, which being cut, you may also inspect the White Compag of the membranous Cells, making the mote inward substance of their noble machine of Air.

These thin Cells of Air seem to be framed of the fine inward Coat of the Bronchia, which being variously distended, do produce the Airy *Sinus*, which

which accreſcing to the Sides, and extremities of the Branches relating to the Wind-pipe, and do terminate into unequal *Areae* and Vesicles.

And it is moſt conſonant to reaſon, that the membranous *Sinus* ſhould be a continuation of the inward Tunicle of the Bronchia, and that theſe numerous curious Receptacles of Air ſhould be appendant to the ramifications of the *Aspera Arteria*, that the Air might be in one continued ſtream, and flow into the numerous Pipes and their appendages, for the more eaſy ingreſs and egreſs of it in inſpiration and expiration, of which the one is celebrated by the diſtention of the Pipes, and their appendant *Sinus*, and the other by Compreſſion, made by the abdominal Muſcles, and weight of the Lungs, and the Contraction of the fleſhy Fibres, beſetting the *Aspera Arteria* and its adjacent *Sinus*.

This may ſeem to prove this Hypotheſis, That the membranous Cells are the off-ſpring of the inward Tunicle of the Wind-pipe, becauſe in dried Lungs, the inward Coat of the *Aspera Arteria*, and its appendant *Sinus*, have the ſame ſubſtance, colour, and transparency.

The Lungs are furniſhed with many ſmall Glands, ſeated between the reticular Tunicle of the Veſſels, and the inward coat of the Bronchia, and the uſe of theſe Glands is (as I imagine) that they may ſeparate the Lympha from the Blood and nervous Liquor, and carry it into the Origen of the Lympheducts, and afterward convey it into the ſubclavian Veins, and mix it with the Blood.

Theſe Glands, I conceive have another uſe, as being conglobated; whereupon ſome part of the Lympha (as I conceive) may be tranſmitted through ſecret Pores, into the Cavity of the Bronchia, and membranous Vesicles; leſt they ſhould be too much exſiccated by the heat of the Blood (paſſing through the Bronchial Artery, into the ſubſtance of the *Aspera Arteria*, and its *Sinus*) ſo that they cannot be freely diſtended and compressed without Laceration, in the Ingreſs and Egreſs of Air, in Inſpiration and Expiration.

CHAP.

C H A P. XXXIX.

Of the Lungs of greater Animals.

THE Lungs of greater and more perfect Animals have much Analogy with each other in their Structure, as consisting of a spongy substance made up of numerous Branches of the *Aspera Arteria*, called Bronchia, to which are appendant many Vesicles, filled with Air in Inspiration; and are not only furnished with Pipes and Cells of Air, but with many Divariations of Arteries, Veins, Nerves, Lympheducts, integrating the rare Compage of the Lungs, immured within a fine membranous Enclosure.

The Lungs of greater and less Animals do differ from each other in their colour, shape, more or less spongy Compage, and multitude of Lobes.

The Lungs of a Lion, described by the Learned *Parisian* Anatomists, are furnished with only six Lobes, as being a sick and decayed Lion, in his noble parts, by reason Renowned *Borichius* in a sound Lion that he Dissected, recounteth Eight Lobes, Four being seated in the Right, and Four in the Left Side.

Diseased Lions die of Asthmas, being subject to great obstruction of the Bronchia, and appendant Vesicles of Air, produced by a thick mucous Matter, stuffing up their Pipes, and hindring their Reception of Air; whereupon they dye suffocated.

The Left Side
of the Lungs
of a Calf.
The First
Lobe.

The Left Side of the Lungs of a Calf is composed of Three Lobes; the First taketh its progress upward, and is endued with a pyramidal Figure, whose Cone looketh toward the Neck, and its Base toward the Second Lobe, to which it is adjoined.

The Second
Lobe.

The Second Lobe is seated in the middle, between the Pyramidal, and the greater and lowest Lobe, to which it is fastened, and passeth cross-ways toward the Left Side; and its upper Surface hath a plane oblong form, and its lower Region is decked with a tricuspidal Figure.

The Third
Lobe of the
Left Side.

The Third and lowest Lobe in the Left Side, is much greater than any of the other, and is very thick in its Origen and Body, and is endued below with a very thin Margent.

The upper-
most Lobe of
the Right Side
The Second
Lobe.

The Right side of the Lungs is framed of Four Lobes, the uppermost hath a kind of Semicircular Figure, and is seated in the highest part of the Thorax.

The Second Lobe taketh its progress transversly toward the Right Side, and is endued with an oblong narrow flat shape in its upper Region, and in the lower part is adorned with a tricuspidal form, somewhat like the Second Lobe of the Left Side.

The Third
Lobe.

The Third Lobe is lodged under the lowest, and is the most small of all the Lobes, and is larger in its Origen, and more narrow in its Termination, and hath a ridge passing all along its upper Region.

The Fourth
Lobe belong-
ing to the
Right Side of
the Lungs of
a Calf.

The Fourth Lobe relating to the Right Side of the Lungs of a Calf, far exceedeth in Dimensions all the other Lobes belonging to it, and hath a protuberance running all along, and endeth in a kind of Cone, and is encompassed for the most part with a thin Margent.

The

The Lungs of a Sheep do hold much Analogy with those of a Calfe, as to their number of Lobes, and likeness of Figure.

The Lungs of a Camel and Bear, have much affinity with those of perfect Animals, only they differ in greatness of Dimensions: and as being very large, have only one Lobe seated on each side.

In a Tigre the Lungs are found jagged, and hued with a Red colour; sometimes this Animal is liable to Inflammations, Abscesses, and Ulcers of the Lungs.

A Guiney Hog hath Lungs consisting of Seven Lobes, Three lodged on each side of the Heart, and one in the middle running up the length of the Heart toward the Cone.

But the Lungs of an Otter are endowed only with Six Lobes, encircling each side of the Heart, and arrayed with a Yellowish colour, which is rare in the Lungs of Animals.

The Lungs of a Hare are beautified with a bright Red, and the Heart is encompassed on each side with three Lobes, one greater and two lesser ones, and the Seventh may be discovered about the Back of a more spongy substance than the rest, as Learned Thomas Bartholine hath observed.

An Animal (called *Hyena* by the Latines) hath beautiful Lungs, as adorned with variety of colours, Brown shaded with White, and bespecked with numerous Purple spots.

The Lungs of a Porcupine are admirable in reference to number, as being Fourteen small Lobes, of which Seven encompass the Heart on each side.

A Bever hath Lungs of a very spongy substance, beautified with a Whitish colour, interspersed with somewhat of Red.

A Civet Cat hath each side of his Heart immured with Three Lobes, endowed with a Red colour, interspersed with Black lines, somewhat resembling a Spiders web in fineness.

The Lungs of a Tortois are Two, on each side one, of a very light and spongy substance, as composed of many vesicular *Sinus*; and take their progress from the Neck all along the Back, and seem at last to be composed of divers parts, which are several Vesicles of Air, running one into another, so that when they are blown up, they seem to make but one great Bladder.

CHAP. XL.

Of the Lungs of Birds.

THE Lungs of Birds are no less admirable than those of more perfect Animals, in reference to their excellent structure, contrived with great artifice (speaking the infinite wisdom of the Omnipotent Protoplast) as they are a rare Systeme, composed of many pulmonary Arteries and Veins, making numerous Divarications, finely wrought in the form of curious Network; and above all, the *Aspera Arteria* is divided, and subdivided into greater and smaller branches (the associates of Arteries and Veins) to which are appendant many small Cells or Vesicles of Air, which is discharged out of the Ramulets of the Bronchia, into these fruitful *Sinus*, as so many receptacles of Breath in Inspiration.

This rare Compage of the Lungs of Birds, is chiefly different from that of other more perfect Animals, as it is affixed to the Back and Ribs; whereas the Lungs of other Animals are left loose, that they may have a freedom to be expanded, and contracted in Inspiration, and Expiration; but the Lungs of Birds being fastned to the Back and Ribs, have many perforations into the Abdomen, through which the Air hath a free Egress and Ingress, out and into the body of the Lungs, in Inspiration and Expiration.

The Lungs of Birds are every way encompassed with a thin dense Membrane, composed of many Fibrils (running in straight, oblique, and transverse positions) so curiously interwoven with each other, that they seem to be one entire piece; as the Fibrils have no visible Commissures or Seams, where they are conjoyned.

At some distance from the Lungs is seated another more thick and strong Membrane, integrated of greater membranous Fibres, making their progress in various postures, and curiously set together, interspersed with many fleshy Fibres (coming from the Ribs, and inserted into this dense Membrane) by which this Coat is affixed to the vertebres of the Back.

The Air being impelled through the greater and smaller Branches of the Bronchia, terminating into common Ducts, which perforating the substance and proper membrane of the Lungs, do transmit Air into the Cavity of the Venter, where it is stopped in its current by the interposition of the Membrane (adjacent to the Lungs) as by a Wall.

Respiration in Birds, as well as other Animals, consisteth of a double operation, Inspiration and Expiration, wherein the Lungs are expanded by the reception of Air in the First, and contracted upon the exclusion of it in the Second.

Inspiration is performed in Birds by an impulse of Air, made by the weight of the incumbent Atmosphere, crowding one part after another through the Mouth and *Aspera Arteria*, as greater Channels into the smaller Pipes of the Bronchia, through which it is transmitted into a common Trunk, (made up of many extremities of Arterial Branches) piercing the Body and Coat of the Lungs, into the empty space of the lower Apartment, wherein the impelled Air sporteth, and expandeth the neighbouring Membrane, whereby the adjoyning Intestines, being compressed, do relaxe the Abdominal Muscles.

Expiration

Expiration is a different Motion of the Lungs (as following Inspiration) produced by the Air, after it hath been impelled through Trunks, and various Ramulets of the *Aspera Arteria*, and the common Ducts, perforating the Compag, and Membrane of the Lungs) making a strong appulse upon the adjacent Membrane; whereupon its tender *Texture* being irritated, draweth its carnous Fibres (derived from the intercostal Muscles) into Consent, so that these fine Engines contracting, do draw the Membrane inward, which is assisted by the abdominal Muscles, pressing the Intestines toward the Back, forcing the adjacent Membrane of the Lungs inward, whereby the inspired Air is repelled through the perforations of the Lungs, and common Ducts, to the terminations of the Bronchia, and from thence through less, and greater Branches of the *Aspera Arteria*, into the Mouth.

This Membrane enclosing the Lungs of Birds at a distance, and confining the extravasated Air, transmitted through the perforated Lungs, is furnished with many fleshy, and membranous, or fine tendinous Fibres, making a kind of fine muscular Expansion, supplying the place of a Diaphragme, and different from that of other more perfect Animals, upon a double account, by reason, First this of Birds when relaxed, hath its Concave Surface facing the Lungs, and Convexe toward the Intestines; but the Diaphragme of Man and Beast in its state of restitution, hath its Convexe Surface bending toward the Lungs, and its Concave facing the *Viscera* of the lowest Apartment; Again, this membranous Contexture, interlined with fleshy Fibres, may be discriminated from the Midriff of other Animals, by reason the First, when it is contracted, lessens the peculiar Cavity, in which the Lungs are lodged; and thereby squeezeth the extravasated Air into the perforations of the Lungs; but the Diaphragme of other Animals, when contracted, doth enlarge the Perimeter of the Thorax in length, to give entertainment to the Lungs, dilated with Air.

CHAP.

Of the Lungs and Gills of Fish.

C H A P. XLI.

WHales, and all cetaceous Fish have Lungs much resembling those of Quadrupedes in their Divarications of the Bronchia, Vesicles, and Blood-vessels.

The Lungs of
a Porp. is.
†. T. 41.

The Lungs of a Porpess are furnished only with two Lobes, † on each side one, encompassing the Right and Left Region of the Heart, they are most thick in their Origins, and grow into more narrow and thin Expansions about their Terminations; and are beautified with a pale Red, and in one part do somewhat adhere to the Midriff, and are every way immured within a strong Membrane.

The substance
of the Lungs
of a Porp. is.

As to their substance, they may be stiled a curious Compage, made up of numerous greater and smaller Branches of Air-pipes, and appendant Sinus, accompanied with many pulmonary and bronchial Divarications of Arteries and Veins, framed in reticular Plexes, which I plainly saw in a Dissected Porpess, with Wonder and Delight.

The Lungs of
Fish have
their blood-
Vessel accom-
panied
with Nerves
The Bronchia
of the Lungs
are beset with
many minute
Glands.

The Lungs in this Fish are accommodated with many Nerves, branched through the substance of the Lungs, and accompanying the Blood-vessels.

The Bronchia are associated with many small Glands, which Dr. Tyson observed to be *Steatomatous* in a Porpess he Dissected. And I humbly conceive that humane Lungs, have Glands too, seated about the Divarications of the *Trachæa* in the substance of the Lungs, and the use may be to percolate the Blood, whose purer part is received into the extremities of the Veins, and the recrements into the origins of the Lympheducts, and conveyed into the subclavian Vessels.

The Gills of
Fish are made
up of many
Blood Vessels
affixed to
semi-circular
bony Pro-
cesses.

The Gills of Fish are Systemes of numerous Branches of Arteries and Veins formed into Arches, and affixed to bony Processes, to keep them in due order, and to give them a defence against the assaults of ill accidents.

These curious Contextures of Vessels have some affinity with those of the pulmonary Arteries, and Veins, as the Blood, coming from the Ventricle of the Heart in most Fish, is first impelled into the Trunk and Branches of the *Aorta*, and then into the Branchial Arteries, and afterward received into the extremities of the Branchial Veins, so that the Blood of Fish maketh a circuit through the various Blood-vessels of the Gills, in some manner resembling that in the pulmonary Vessels, whereby the Blood of Fish is impregnated with airy Particles in the Gills, as well as in the substance of the Lungs relating to other Animals.

The manner
of the pro-
gress of the
Arteries and
Veins into the
Gills,
†. T. 29.

And now I will endeavour to give you an account of the Fabrick of the Gills in a Skaite, and of the Trunk and Divarications of the Artery, † entering into them after this manner; out of the base of the Heart ariseth a great Trunk of an Artery, (encircled with a white hard Shell) which climbeth upright single, for an Inch or thereabouts, and is then divided into Two Branches, on each side one, and afterward each Branch is subdivided into three, which on each side run along the lower Region of the Three first bony Arches of the Gills, which are beset with many minute Divarications, sprouting out of the first greater Branches, and end into one common Trunk.

And

And about an Inch or more above the First Branches of Arteries, ariseth on each side one, springing out of the arterial Trunk, and each of them is subdivided into a pair of Branches, which take their progress all along the lower part of the two semicircular bony Arches, belonging to the upper Gills, and these greater Branches are again divaricated into many smaller Ramulets, terminating into one common Trunk, which wheeling backward, is afterward divided into numerous arterial Branches, transmitting Blood into all parts of the body of Fish, which is brought back again to the Heart by venous Branches and Trunks; so that every indentment of the semicircular Arches (garnished with many Branches of Arteries) is again answered with an equal number of venous Divarications; And those of the descendent Trunk of the *Cava*, do address themselves to the ascendent of the *Aorta*; and the Branches of the ascendent Trunk of the *Cava*, do apply themselves to those of the descendent Trunk of the *Aorta*, which may be manifest by opening the arterial and venous Branches, appendant to the lower regions of the arches of the Gills, fringed with many Red indentments, into which may easily be seen the rows of holes leading into them; so that a Black Liquor being injected into the Arteries of the Gills, it will return again by the Veins; And the Black Liquor being immitted into the Arteries, some part passeth into the Fringes of the Gills and another part is carried in a straight course into the descendent Trunk of the *Aorta*; whence it may be clearly deduced, that the Gills in Fish, do supply the place of Lungs in more perfect Animals, through which the Blood taketh its circuit, to be impregnated with the more pure and nitrous parts of Air, which being associated with Water, are received into the Mouth and Gills of Fish, and affect the Blood, passing up and down the Red Fringes of the bony Arches, which are ranks of Arteries and Veins, exporting and importing vital Liquor from and to the Heart.

The Second
progress of
the Arteries
into the Gills.

The Arteries
of the Gills
are answered
with an equal
number of
Veins.

An experi-
ment to
prove some
part of Li-
quor, passeth
into the
Gills; and
another part
into the de-
scendent
Trunk of the
Aorta.

Water inspi-
red with
Air, may goe
into the Ar-
teries, and
mixe with
Blood, passing
through the
vessels of the
Gills.

So that the Water inspired with the more thin and nitrous Particles of Air, may diffuse it self through the Pores of the Arteries (affixed to the Red Arches of the Gills,) into the mass of Blood, passing and repassing through Arteries and Veins, from and to the great machine of Motion, making good the circulation of the Purple Juyce.

Whereupon Fish may be said to have a kind of Respiration, made in a frequent Reception, and spurting out great streams of Water, inspired with Air, which being transmitted through the Gills (dressed with Arteries and Veins) enobleth the Blood with elastick and spiritous Particles, which do very much contribute to the preservation of the vital flames, which is extinguished in Fish residing in waters, enclosed with Ice, wholly intercepting the current of Air.

C H A P. XLII.

Of the Lungs of Frogs, Lizards, Vipers, &c.

The Lungs of Frogs are Systems made up of various Vessels. The Lungs of Frogs consist of two Lobes.

THE Lungs of Frogs are worthy our remark, as being contrived by Nature, with great Artifice, and are a rare Compag made up of various Vessels, Arteries, Veins, Nerves, and Branches of the *Trachææ*, interspersed with divers Cells, as so many Receptacles of Air.

This rare contexture of different Tubes is divided, as it were into two Lobes, enclosing each side of the Heart, and each consisting of a large Bladder, beset in the inside with numerous *Sinus*, somewhat resembling the Cavity of a Honey-comb.

The Cells of Air have their Area shaded with many Sanguiducts meeting in a kind of Network. The minute Cavities of the Lungs are beset with Air.

The various minute Cells of Air have their *Area* shaded with various Cylinders, with numerous Blood-Vessels running in many Flexures, made by the frequent association, and parting of the Branches of Veins and Arteries (whence ariseth a kind of fine Network) terminating into the substance of the small Vesicles, beautifying the greater bladders of the Lungs.

The minute *Sinus* of the Lungs are propagated from the more large Bladder, and are many small Cavities, whose sides are immured with thin Membranes, consisting of divers Angles, and are Hexagons, as most ingenious *Malpighius* will have them.

These fruitful Vesicles are expanded with Air, (transmitted by the *Aspera Arteria*, and numerous Branches) which is insinuated by many very little Pores, into the substance of the *Sinus*, where it associates with the Blood, brought in by the terminations of the Bronchial Arteries; and afterward the Blood, embodied with Air, is received into the Extremities of the pulmonary Veins.

The numerous Ramulets of Arteries and Veins are carried in crooked lines.

And I most humbly conceive, that the innumerable Ramulets of Arteries and Veins have their progress, not in direct, but crooked lines, to give a check to the over-hasty streams of Blood, that they may receive the greater impregnation of Air, and that the Chyme may be more perfectly mixed with Blood, as being long entertained in the many Meanders of Vessels, wherein the different Liquors of Blood and Chyme may be broken into Atomes, by repeated alternate acts of Inspiration and Expiration, in order to a more perfect mixture tending to assimilation.

The Lungs of a Snake. 1. T. 41. F. 2. k. k.

The Compag of the Lungs of a Snake, is framed of numerous Vesicles of Air, endued with a membranous substance; and the outward coat of the Lungs is very remarkable for many Vessels † passing crosswise in crooked lines, from one side to the other; and the Lungs are adorned with a conical Figure, as beginning and ending in a Cone.

The spongy Lungs of Vipers, Tortoises, &c.

The Lungs of Toads, Lizards, Vipers, Camelions, Tortoises, Water-Salamanders, &c. have the same structure with a Frog, as being very light and spongy, as composed of numerous little Bladders, inclosed with fine Membranes, and enamelled with variety of Blood-vessels, (and Nerves) curiously wrought, after the manner of Network.

The Fabrick of the Lungs of minute Animals, are Transparent.

In these more minute Animals, the fabrick of the Lungs is more conspicuous as vesicular, and transparent, because the Sanguiducts are smaller and thinner in their Coats; and as the *Sinus* (bedecking the inside of the greater Bladders)

Bladders) are encompassed with finer Tunicles; Whereupon the rare Compage of the Lungs is more manifest, and holdeth a great Analogy with the frame of more perfect Animals, which is less distinct, and more gross, as filled with a great quantity of Purple Liquor, and its large Vessels, do much cloud the Vesicles of the Lungs.

C H A P. XLIII.

Of the Lungs of Insects.

INsects being the Epitome of greater Animals, in reference to their noble parts; and although they have no distinct Lungs, not composed of a Parenchyma, integrated of variety of Vessels, and Membranous Sinus; yet they have numerous Pipes of Air (Analogous in some sort to the Lungs of more perfect Animals) imparted in numerous Divarications to the *Viscera* and Muscular parts of the Body.

The Trachæe of Insects hold Analogy in some sort with the Lungs of more perfect Animals.

In Insects under their Fibres, many spots may be viewed, or as I conceive, the Orifices of innumerable vessels of Air, beginning about the Second and Third rings, or incisures of the Back. These Pipes of Air have no manifest Trunk, but in every Orifice in some Insects may be seen Ten, and in a Silkworm Eighteen Branches, or more of Air-vessels, which end into one common Duct, from this aperture, or rather from a short Trunk many Plexes do arise, which do communicate themselves upward and downward, holding a natural Entercourse by various Inosculation from the Head to the Tail, as Learned *Malpighius* hath discovered.

From the same Origen many Circles are propagated, which do furnish the habit of the Body, and Muscles with many *Trachææ*, visiting the neighbouring *Viscera* in their progress through the territories of the Body, wherein they make divers Divarications, which perforate each other in several Branches, so that Air is transmitted from one Ramulet to another, that the free current of Air might pass through all parts of the Body, which if it should be checked in some Branches, (caused by some obstruction,) it may have recourse immediately to some other adjoining Branches, with which they hold correspondence by *Anastomosis*.

These *Trachææ*, resembling the Bronchia of the Lungs, are divaricated after the manner of Arteries, whose Branches obtain less and less Dimensions, as they pass to a greater and greater distance from their Trunks, making reticular Plexes, as may be observed in the foliage of Trees, which is most pleasant to behold.

The Trachææ are divaricated after the manner of Arteries.

These numerous Flexures and Gyres of the Air-Vessels may be seen immediately under the Skin in the Muscles, and in all other parts of the Body; They are coated with a dark hue, and afterward become bright, as beautified with a kind of Silver colour, and sometimes with a Pearl, and sometimes Straw or Gold colour.

These Air-Vessels, forming the Lungs of Insects, are made of a thin Membranous substance, composed of many fine Fibres, curiously interwoven.

The

The Origen
of the *Trachææ* are de-
rived from
the Incisures
as from
Trunks.

The Incisures adorning the Backs of Insects, are furnished as it were with Two lobes of Lungs, derived from their Origins, seated near the Backs of these Animals, so that every ring is accommodated with an *Hiatus*, or kind of Trunk, from which the various Plexes of Air-pipes in Insects are propagated; these Rings, or Incisures of Insects, are dressed with a kind of Black Girdle, and in a Palmer-worm, and the like Insects, the formation of Air-vessels is made after this manner: the outward skin is bespecked with divers oval spots, which are the Origins of the *Trachææ*, or beginning of the Lungs, some of which are divaricated about the Incisures of the Back, and others are carried toward the lower region of the Venter, and in their progress above and below, they do bestow many Branches upon the Muscles and *Viscera* of the whole Body; to assist the concoction of Aliment in the Stomach and Intestines, and to improve the Blood in its circuit through all parts of the Body.

CHAP. XLIV.

Of the Aspera Arteria, or Wind-pipe.

THE Windpipe is so styled from its use, as being made by Nature for the reception and transpiration of Air into the substance of the Lungs, and hath the appellative of *Aspera Arteria* from the antient Anatomists, by reason of many unevennesses, as encircled with numerous prominent Cartilages, seated above its Membranes.

This fine Tube of Air hath its situation in the fore part of the Neck, leaning in its hinder region upon the superior part of the Gullet, lodged between the Vertebres and Windpipe; and hath one continued Duct, like a Trunk, reaching from the Fauces, or hinder part of the Mouth to the Lungs, and is connected above to the Muscles of the *Os Hyoides*; and when the Windpipe enters into the upper region of the Thorax, the Origins of the *Musculi Mastoidei* do border upon this Tube, to secure it from any violence in the motion of the neighbouring parts.

This Pipe of Air is a Cylinder, as endued with an oblong round Figure, in some parts more depressed, in others more orbicular: so that the anterior part of it when distended, is more round, and the posterior region, when rendred more lank, as empty of Breath, groweth more flattish, and tendeth toward a plain; the top of this Tube hath more large Dimensions, and afterward hath its bore somewhat lessened.

The *Aspera Arteria* in its upper part, before it arriveth the Lungs, doth somewhat resemble a Trunk of a Tree (in its outward shape) as free from all Limbs, and when the *Aspera Arteria* cometh over against the Fourth Vertebre of the Back, is divided into Two Branches, which being propagated into the Lobes of the Left and Right Side of the Lungs, do sprout into fruitful Ramulets (like so many roots of a Tree) implanted into the substance of the Lungs.

The Wind-pipe consisteth of many parts, the head of it is called *Larynx*, the middle or single Tube may be called *Bronchus*, which is seated between
the

the *Larynx* and Lungs, and afterward it may be named *Bronchia*, from their Plurality as being many Branches, and Ramulets of the *Bronchus*, when they enter into the body of the Lungs, in most numerous sprouts.

The *Larynx*, or top of the *Aspera Arteria*, is composed of divers substances, which are Membranous, Cartilaginous, and Muscular, beset with many different Tubes, Importing and Exporting various Liquors, of which I intend a particular discourse in the next Chapter.

The middle of the *Aspera Arteria*, called the *Bronchus*, is also Membranous, and Cartilaginous (but not Muscular) inclosed too with various Vessels; and hath one continued single Duct, reaching from the Mouth to the Fourth Vertebre of the Back.

The *Bronchia* or Branches of the Wind-pipe, are integrated of divers substances, some part is membranous, and another Cartilaginous, and a Third wholly Membranous, as ministerial to different ends.

The *Bronchia*, when they are entred into the Body of the Lungs, alter the Figure of their Cartilages, and grow in some places perfectly orbicular; in others triangular and quadrangular; and when the *Bronchia*, associate with the Sanguiferous Vessels, they quit their Cartilages, and turn wholly Membranous, lest they should discompose the whole tender frame of the Vessels, by gauling them with their hard Compage, and when dilated, should too much narrow the small bones of the Sanguiducts, and hinder the motion of the Blood through the substance of the Lungs.

So that this curious Tube of Air hath a rare Mechanisme, as being a Compage made up of divers Integrals, Membranes, Cartilages, Arteries, Veins, Nerves, and Muscles, guarding the Heads of it, and are so many Machines ministerial to various motions of the Cartilages, productive of Speech.

The outward surface of the Wind-pipe, beside that of the *Larynx*, is endued with divers Asperities, so that it seemeth unequal in many regular ranks of prominencies, and for the most part circular Cartilages; as with so many Ribs, and when this Cylinder is distended with Air, it is smooth in its hinder Region, as being a continued Membrane, destitute of Cartilages; but this Wind-Tube is full of unevennesses in its lateral and anterior Region, as the Membranes are interspersed with many protuberant Cavities, rising above them.

This surface of the outward Coat, being Membranous (as lodged between the numerous rows of Gristles) hath a connexion by the interposition of many thin Ligaments, to the upper part of the *Æsophagus*, and the *Larynx* is tied to the top of the Gullet, by the mediation of many small Muscles, which embracing the top of the Gullet, as in some part implanted into the buckler Cartilage, and the forepart and sides of the Wind-pipe are affixed to the Blood-vessels, and chiefly to the recurrent Nerves, which are adjoyned to the *Aspera Arteria*.

The inward surface of the Wind-pipe (bating the unevennesses of the Cartilages, giving strength to the tender membranous structure) is very smooth and slippery, as anointed with an unctuous Matter.

The Wind-pipe is composed of many Membranes, of which the outward is very thin (made up of many minute Fibres, running in different Positions, and curiously interwoven) by which it is tied to the annular Cartilages; This Coat is derived, as I conceive, from the *Pleura*, (the common reputed Parent of all the outward Membranes in the Thorax,) encompassing the *Viscera*.

The inward Membrane (investing the inside of the *Aspera Arteria*) is more thick then the former, and much contributeth to the Connexion of the Membranes with the annular Cartilages.

This inward Coat of the Wind-pipe is lined with a Mucilaginous humor, to soften the voice which is rendred hoarse, when this humor is mixed with thin, or salt Catarrhs, or exsiccated by immoderate heat.

This unctuous humor, with which the inward Coat of the *Aspera Arteria*, is embrochated, is transmitted from the terminations of the Bronchial Artery; or when it doth abound, or is mixed with Saline Recrements, is the cause of a Cough, caused by discomposing the inward Coat of the *Aspera Arteria*.

The inward Coat is furnished with many Right and annular fleshy Fibres, which by contracting themselves, do give it a power to narrow the Cavity of the Wind-pipe, and by brisk Contractions, to throw up the offensive Matter, either lining the inward Coat of the *Aspera Arteria*, or thrown out the Bronchia of the Lungs into the greater Trunk, and afterward into the Mouth.

Between the outward and inward Membrane, is lodged an intermedial proper Coat of a divers substance from the other, partly Cartilaginous, and solid to form the sound of the voice; and partly ligamentous, whereupon it is capable to be expanded and contracted in successive Motions in the reception and return of Air in respiration.

The use of this rough Artery is to receive and transmit Air by Inspiration, into the Lungs, through many small Pipes, branched every way through the substance of them; And also the Lungs when they have received the more volatil, nitrous, and elastick parts of Air into the mass of Blood, they throw out the more effate and sluggish Atomes, with the fuliginous steams of the Blood, First, through the minute Pipes into a greater Trunk, and afterward into the Mouth.

Whereupon the Grand Architect hath most wisely contrived this fine Cylinder to be made for the greatest part of a membranous substance, to render it capable of Dilatation in the reception of the elastick Particles of Air in Inspiration, and to be able to contract it self in Expiration, when the Lungs do subside for the exclusion of Air, and the smoaky reeky vapours of the Blood.

This fine Tube is not only framed of a Membranous, but of a Cartilaginous substance too, as consisting of many grizly Rings, besetting the membranous Compage, to keep it constantly open for the free Ingress and Egress of Air, and the gross effate steams of the Blood; and I humbly conceive that this choice Cylinder was furnished with numerous, almost circular Cartilages, to render it Rigid and Tense, in order to the formation of the voice, by making brisk verberations, or appulses of expired Air, against the inside of numerous Cartilages.

The Bronchia are furnished with an Artery (imparting many Branches to the Wind-pipe) First discovered by Ingenious *Frederick Ruisch* *Hanc Arteriam, inquit, Bronchiale appellare visum fuit, supra Bronchia enim Serpens, ea concomitatur ad finem usq; Ortum sumit ab Arteriae magnae descendens postica parte, digiti latitudine plus minus, supra supremas arteriolarum intercostalium, ex Aorta descendenti exortarum; aliquando etiam Duorum Digitorum latitudine supra Arterias modo dictas; nonnunquam etiam infra eas, originem habere Comperio: placet enim naturae aliquando varietate frui. Nunc unica assurgit, nunc gemina, ita ut saepius, Arteria magna cadavere exempta, intercostalibus*

intercostalibus & Bronchialibus abscissis, Trunculi Bronchialium remanentes, exortum Intercostalium mentiantur. Hinc pulmones oblique subit, Bronchiaq; sub Arteria venosa ad extremum usq; Comitetur, donec Capillaris facta visus aciem effugiat. In pulmonibus humanis observavi, hanc Arteriam sepius anticam Bronchiorum perreperere partem, quod in brutorum pulmonibus raro vidi.

The Bronchial Artery branched over the Bronchia, is attended with numerous Divarications of Branches of Veins, as the Associates of the Bronchial Artery, the one importing Blood to the Bronchia, and the other exporting it from them.

The Bronchia of the Lungs are not only beset with Arteries and Veins, but with Nerves too, as both their associates, which being derived from the *Par Vagum*, do transmit many Fibres into the Membranes of the Bronchia.

C H A P. XLV.

Of the Larynx, or Head of the Wind-pipe.

THE *Larynx*, or Head of the *Aspera Arteria*, is the most eminent part of the Windpipe in reference to Order and Dignity, as it formeth and modelleth the voice more Grave or Acute by the greater or less Contractions of the Eurlike Cartilages, made by more strong or soft motions of different Muscles, belonging to the Larynx.

This choice part of the Wind-pipe is beautified with a circular Figure, more protuberant in its anterior region, and more depressed in the hinder, that it might more easily comply with the deglutition of Aliment, especially when it is solid.

The Figure of the Larynx.

This rare Head, adorning the Cylinder of Air, is a fine Compage framed of variety of parts, Membranes, Cartilages, Vessels, and Muscles; As to the Membranes, they are the same with the other part of the Windpipe, as composed of an outward more thin, and inward more thick Coat, which are guarded within the confinements of more solid Cartilaginous and Muscular substances.

The Composition of the Larynx.

The *Larynx* is made up of many Cartilages as well as Membranes, which famous *Columbus* (an antient Anatomist) calleth Bones, as endued in their more inward Recesses, with a medullary substance, which I have not been so happy to see; this bony substance is only found (as I conceive in persons very antient) whose Cartilages of the Larynx are turned into Bones, as having their more soft parts exhausted by age; whereupon they become more indurated, and solid.

The Cartilages in antient Persons, grow sometimes bony

The First is called the Buckler Cartilage, and hath its appellative from the resemblance of an oblong quadrangular Shield, which the Antients used in War, and the *Turks* now manage in their defence in Naval Fights; or like a Breast-plate of Iron, outwardly Convexe and Prominent, and inwardly of a Concave Surface.

The Buckler Cartilage.

This Cartilage is adorned with four Processes, the Two upper seated in each Angle, are the longest, being affixed by the interposition of Ligaments or Membranes, to the lower sides of the *Os Hyoides*; and the other

The Four Processes of the Buckler Cartilage.

more

more short processes of the buckler Cartilage, are conjoined to the annular Cartilage, somewhat inclining to its hinder region.

The Muscles
of the Buck-
ler Cartilage
The First pair
of Muscles
called *Hyothy-
roides*.

The Buckler Cartilage is accommodated with two pair of Muscles (which are called Common) the First are named *Hyothyroides*, which cover the Convex part of the Buckler Cartilage, and take their origination from the lower Margent of the *Os Hyoides*, and are inserted into the lower part of the Buckler Cartilage; these Muscles being contracted, do lift up the Buckler Cartilage, by bringing it more and more toward the *Os Hyoides*, and thereby

The Second
pair of Mus-
cles called
*Sternothy-
roides*.

The Second pair of Muscles belonging to the Buckler Cartilage, are called *Sternothyroides*, as taking their rise from the upper, and inward part of the *Sternum*, and are inserted into the lower side of the Buckler Cartilage, and by the motion of these Muscles, the Buckler Cartilage is drawn downward toward the *Sternum*.

The Third
pair of Mus-
cles, called
Cricothyroides.

The Third pair of Muscles, which are very small, and have the Appellative of *Cricothyroides*, as having their Origens derived from the anterior part of the annular Cartilage, and do terminate into the lower region of the Buckler Cartilage.

The Second
Cartilage
of the Larynx
named *Cri-
coides*.

The Second Cartilage appertaining to the *Larynx*, is entitled *Cricoides*, or the annular Cartilage, because its anterior Region is beautified with a round Shape, and hath a broad Plane backward, somewhat like a Seal set upon a Ring, and this Cartilage is called annular, as much resembling the Ring, which the Turkish Archers use in drawing their Bows.

The Third
and Fourth
Cartilages are
Ruled *Aryta-
noidei*.

The Third and Fourth Cartilages, relating to the *Larynx*, are styled *Arytenoidei*, by reason when they are conjoined, they resemble the Lip of an Euer in Figure, and constitute the Rimula or Chink of the *Larynx*, commonly called *Glottis*.

The Rimula

The Rimula, consisting of these Two Cartilages, is acted with Four pair of Muscles, modelling the voice after the variety of tones, according as these Muscles do play in several Contractions.

The Musculi
Thyroarytanoidei,
relating
to the Eure-
like Carti-
lage.

The First pair of Muscles belonging to the Eure-like Cartilages, are *Thyroarytenoidei*, which do borrow their Origens from the middle, and interior part of the Buckler Cartilage, and climbing upward, are implanted into the Sides of the Eure-like Cartilages; These Muscles being Contracted, do by compressing the Eure-like Cartilage, straighten the Rimula of the *Larynx*, and render the voice more acute.

The Second
pair of Mus-
cles, called
Arytenoidei,
which relate
to the Eure-
like Cartilage

The Second pair of Muscles, called *Arytenoidei*, being very small and fleshy, do fill up the space between the *Cycoidei*, and *Arytenoidei*, deriving their beginning from the Eure-like Cartilages (where they are conjoined to the annular Cartilage) and are terminated into the Eure-like Cartilage; and these Muscles in their Contractions, pulling the Base of these Eure-like Cartilages downward, do open the Rimula of the *Larynx*.

The Third
pair of Mus-
cles, called
Cricothyroides

The Third pair relating to the Eure-like Cartilages, are denominated *Cricothyroides postici*, and are seated in, and take their Origen from the broad Back of the annular Cartilage, and are implanted with a short Tendon into the lower Region of the Eure-like Cartilages, (near the Rimula) which they pull outward, and dilate the Rimula of the *Larynx*.

The Fourth
pair of Mus-
cles, called
Cricothyroides

The Fourth pair are called the *Cricothyroides laterales*, and do borrow their rise from the annular Cartilage, and are inserted backward into the Sides of the Eurelike Cartilages; these Muscles being Contracted, do draw the *Arytenoidei* downward, and open the Rimula of the *Larynx*.

The Fifth Cartilage, appropriated to the *Larynx*, is the *Epiglottis*, so styled, because it is seated at the root of the Tongue, instituted by nature upon occasion, to be a cover of the *Glottis*, or *Rimula Laryngis*, to intercept the disorderly course of Aliment into the Wind-pipe, lest it should, if it receive in a quantity, cause a Suffocation, which happened in a Person of Honour, who being merry with his Friends in eating the Rump of a Pullet, it slipped down the *Aspera Arteria* into the Lungs, and immediately choaked him.

The *Epiglottis*, vulgarly called the Fifth Cartilage of the *Larynx*.

This Cartilage is endued with a softer Consistence than the other, as being covered with a Membranous substance, lined with many small Glands, and hath Dimensions answerable to the *Glottis*, so that if the *Rimula* be greater or smaller, the *Epiglottis* is proportionable to it, and the voice groweth stronger or fainter, according to the largeness or straightness of the *Rimula*, as it is receptive of greater or less impulses of Air.

The Consistence of the *Epiglottis* is softer than the other Cartilage.

Learned Mr. *Steno* giveth an account of the Glandulous substance of the *Epiglottis*; *Observat: de Glandulis oculor: in Epiglottidis Vituli superiore parte notat carnem quandam ex Globis Glandulosis Compositam, a qua per ipsam Cartilaginem, usq; ad inferiorem partem, dicit meatus reperiri conspicuus.*

The Glandulous substance of the *Epiglottis*.

This Ingenious Author hath observed (in the Glands of the *Eies*) in the upper Region of the *Epiglottis* of a Calfe, a kind of fleshy substance (composed of glandulous Globules) from which (he saith) may be found manifest holes passing through the Cartilage, to its inferior Region.

Through these *Meatus* (I humbly conceive) a serous Liquor, secreted from the Blood in the body of the Glands, is conveyed into the *Aspera Arteria*, which rendreth it moist and smooth; and in Man, if this Liquor be Salt and Exuberant, it will irritate the *Aspera Arteria*, and cause a Cough, produced by the aggrieved Muscular Fibres of the Wind-pipe, violently contracting themselves to expel the offensive Matter.

C H A P. XLVI.

Of the Wind-pipe of other Animals.

The frame of
the *Aspera*
Arteria rela-
ting to other
Animals.

THE Wind-pipes of larger, and more perfect Animals, have great similitude in Structure, and may be styled a rare *Mechanisme* (integrated of Membranes, annular Cartilages, Arteries, Veins, Nerves) whose Head is Crowned with various fine Muscles. And when the Bronchia or Branches of the Wind-pipe enter into the Body of the Lungs, where they are made associates with the Blood-vessels, they quit their Cartilaginous nature, and turn wholly Membranous, lest they should give a trouble to the soft frame of the Vessels, in the various motions of the Lungs.

The differ-
ence of the
Wind-pipe
of other Ani-
mals-

The Wind-pipe of more perfect Animals, differ in greater or less bores, and sometimes in the disposition of their annular Cartilages; but those of smaller and less perfect Creatures, as Birds, and cetaceous Fish, have a different *Larynx*.

The Wind-
pipe of a
Lion.

The Wind-pipes of a Lion is different from other great Animals, as having perfect circular Cartilages, except two or three adjoining to the *Larynx*, which were very large (parted with two lines) ordained by nature for roaring. The Eight or Nine upper Cartilages were lodged close to each other, *squammatim*, *aut imbricatim*, with little or no interposition of Membranes (which are found in other Animals) to give the greater strength to the Wind-pipe; the Buckler Cartilage is very oblong, the *Epiglottis* furnished with fine carnosus Fibres, and different from that of a Dog, which hath a Muscle to lift up the *Epiglottis*.

The Wind-
pipe of Sheep.

In a Sheep the annular Cartilages seated above, seem to be different from those that enter into the Lungs, and the *Aspera Arteria* about its division, hath divers hooks, which do not run transversly, but in length, somewhat resembling the Figure of an X

The *Aspera*
Arteria of an
Ape.

A Learned Anatomist affirmeth the annular Cartilages of the Wind-pipe in an Ape to be wreathed, like the spires of the Intestines, and the *Epiglottis* to be free from carnosus Fibres; and between the bifurcation of the *Aspera Arteria* (lodged in the Lungs) are seated many small soft Glands, endued with a deep colour, which are sometimes Red, and othertimes White, or Ash-coloured in a Cat.

The Win-
pipe of a Ca-
melion of
Egypt.

A Camelion of Egypt hath a very short Wind-pipe, made up of many semicircular Cartilages, like those of other Animals, and hath a double *Epiglottis*, closing the chink, seated in the top of the *Aspera Arteria*, which is single in most Animals, and Muscular in Tigers.

C H A P. XLVII.

Of the Wind-pipe of Birds.

THE Wind-pipe of a Swan is adorned with an admirable Fabrick, and being an associate of the Gullet, passeth all along the Neck, till it ariveth the Sternon, into whose *Capsula* it insinuateth it self, with a crooked posture, in which it is lodged as in a safe Repository, and descending to the bottom of this Cavity, it is reflected upward, and creeping out through a narrow passage of the Sternon, climbeth up to the middle of the Clavicle leaning upon the *Trachæa*, as a prop when it bendeth toward the Thorax; and before it cometh to the Breast, and the Lungs contained in it, it seemeth to form a kind of *Larynx* with the *Os Hyoides*, clothed with a broad Membrane; and is like a Musical Pipe, as being more broad above and narrow below, and endued with a small Fissure; under this *Larynx*, made after a manner with the *Os Hyoides*, before the *Aspera Arteria* entreth the Lungs, it is divided into Two Branches (not unlike to Bronchia of other Animals) which grow more narrow as they approach the Lungs, and differ from a humane Wind-pipe, which hath no Divarication till it entreth into the substance of the Lungs; so that this curious structure of the Wind-pipe is highly advantageous for Respiration, while the Swan endeavoureth to support it self by searching out Aliment in the bottom of Rivers, Lakes, and Ponds, wherein this large Bird stayeth a good space of time, with Head and Neck immersed into the shallow water, and Feet turned upward toward the Sky, in which posture, all reception of Air is intercepted, but what it draweth out of the *Capsula* of the Sternon as a Cistern of Breath, with which it is maintained during the time of its Head and Neck are under water.

The *Trachæa* of a Crane maketh a direct progress to the Right Side of the Sternon, into whose Right Tube it is insinuated, which is endued with divers Circumvolutions, till it find a passage toward the Left Tube, while the *Trachæa* tendeth toward the Lungs, making a kind of *Larynx* with the *Os Hyoides*, as hath been described above in the History of the Wind-pipe relating to a Swan.

The *Trachæa*
of a Crane.

The *Aspera Arteria* of a Crane passeth through the Sternon, in various Meanders, by reason the Sternon in this Bird is not endued with one single Cavity, as in a Swan (made for the long recourse of the *Trachæa*) but is wreathed into many Flexures, in which the Wind-pipe sporteth it self up and down in many circumvolutions, resembling the Gyres of a moving Serpent, as Learned Bartholine hath given a most ingenious account, *Hist. 12. Cent. 4.* speaking of the Sternon and *Trachæa* of a Crane. *Sternum psum non simplici Cavitate præditum erat, uti in Cygno notavimus, ad Asperæ Arteriæ oblongum recursum, sed variis ambagibus intus patebat velut labarintheis flexibus, per quos incurvato ductu Serpentis instar, Arteria sursum deorsumque ferebatur, jucundo plane & admirando spectaculo.*

The *Aspera Arteria* of a Parrot is contrived with great Artifice, the Head, or *Larynx* consisteth of divers Cartilages, as the *Hypomochlia* of various motions relating to divers pair of curious Muscles, made for different Dilatations, and Contractions of the *Rimula*, in order to form variety of sounds, somewhat resembling the Articulations of humane voice.

The *Trachæa*
of a Parrot.

The *Trachæa* of this prating Bird, is adorned with many annular Cartilages,

lages, which are not perfectly circular; and the Anterior and posterior part of them, are alternately broader and narrower, and are beautified, not with a Circular, but Oval Figure.

About the lower end, where the Wind-pipe is Divaricated, is placed a Cartilage (decked with an elegant Figure) which seemeth to be entirely one, but is made up of Three Cartilages, of which the upper doth resemble a piece of a hollow Cone cut off, and its Base doth emit Processes on each side, ending into Apexes, resembling those of Quills; and the intermediate space interceding the Apexes, is Semi-circular, to which on each side a Cartilage is annexed, endued with a Parabolical Figure, where it is conjoyned to the upper side; but in the opposite side, it hath as it were Two Horns, and between them a Right Line, as *Ligerus Jacobæus* hath observed.

The Wind-pipe of a Heron.

A Heron hath a *Trachæa* very wonderful in Structure, whose Head is composed of Three Bones, or rather Cartilages (filled up with Muscles, the Engine of various motions) of which the lowermost is affixed to the uppermost Ring of the *Aspera Arteria*, by the interposition of a firm Membrane; The uppermost Cartilages seated on each side, being of a Triangular Figure, do belong to the Palate, and are hollowed outwardly with a *Sinus*, replenished with Muscles, and endued inwardly with an eminent Process, straightening the Cavity of the Wind-pipe, and these higher bones of the *Larynx* are connected to the lowest, by the help of the Membrane, inwardly investing the *Aspera Arteria*, and conjoyning all the annular Cartilages: At the termination of these Bones, where the Rings are united, is seated a jagged Fringe, about whose middle many Glands are seated.

The *Trachæa* of an Eagle.

The *Larynx* relating to an Eagle is encircled with a strong Buckler Cartilage, and is made up of perfect Cartilaginous circles, and the annular Cartilages besetting the other part of the *Trachæa*, do terminate into membranous Expansions adjoining the Gullet, to give way to it, when distended in Deglutition with great gobbets of Aliment.

The *Aspera Arteria* of a Peacock.

The upper part or Head of the *Aspera Arteria* in a Peacock, is furnished with two Muscles, on each side one; and the *Trachæa*, beset with annular Cartilages, hath a peculiar Fabrick, because, after it is entred into the substance of the Lungs, and maketh a Divarication of Branches, those of one side have larger Dimensions than the other, in reference to their annular Cartilages, and emit a Membrane, through which the inspired Air may be transmitted through the Interstices of the Cartilaginous Rings, into the Cavity of the Membranes.

The Wind-pipe of a Pidgeon.

The *Trachæa* of a Pidgeon, hath the *Rimula* of the *Larynx* beset with many White Processes, as so many Glands, and the Wind-pipe doth not take its progress all along the Neck, resting upon the Gullet, as in most Animals, but seemeth to be lodged on its Right side, and sometimes at a distance from it; and near the Heart, the *Aspera Arteria* is divided into Two Branches, which being transmitted into the substance of the Lungs, are not subdivided into more Ramulets; so that the First Divarication of Branches, do terminate into the Perforations of the Lungs.

The *Trachæa* of a Duck.

The *Rimula* belonging to the *Larynx* of a Duck, is dressed with many white protuberances, as so many Glands, and each side of the *Trachæa* is furnished with a small long Muscle, running from the Fauces to the top of the Thorax, and about the termination of the Muscles, the *Aspera Arteria* obtaineth a kind of bony Nature, and greater dimensions, as a large pipe of Air, and is divided into two Branches, which afterward grow Membranous; and all the Cartilaginous Rings are parted before and behind, with a Membranous Line or Interstice, which rendreth the circles of the Cartilages imperfect.

CHAP. XLVIII.

Of the Wind-pipe of Fish.

THE *Epiglottis*, and *Glottis*, or *Rimula* of a Porpoise, being joyntly considered, do somewhat resemble the Bill of a Swan or Goose, only the lower part or *Glottis*, hath a Fissure in its Origen, and the *Epiglottis* being shorter then the *Glottis*, leaveth a great part of the *Rimula* uncovered.

The *Epiglottis* being very thick and Cartilaginous, is welted round about with a Prominent round grisse, and both the *Epiglottis* and *Glottis* have a griffly Compage, covered with a thick Membrane.

The *Epiglottis* is outwardly clothed with a Convex Surface, in which the middle is most Prominent, somewhat like an edge; the inside of the *Epiglottis* is Concave, and it being inspected every way, is but one entire Cartilage, encompassed with a thick Membrane.

The *Epiglottis* is conjoyned on each side to the *Glottis*, by the mediation of a thick Tunicle, and seemeth to take one extremity from the beginning of the Buckler Cartilage, and terminates not far from the fissure of the *Rimula*.

The *Glottis* or *Rimula*, is nothing but a Fissure proceeding from the parting of the Cartilages of the *Arytenoides*.

The *Larynx* of a Porpoise, as well as other cetaceous Fish, and Animals, is composed of divers Muscles (and Cartilages) by which, being variously contracted, and dilated, this Hog-like Animal maketh a different kind of grunting, when he tumbleth near the Surface of the Water, lifting up his Head above it for the reception of Draughts of Air, and then descends, and drencheth his Body and Mouth in Water, treating himself in variety of Elements, to cool and refresh his agitated Body and Blood, produced by long swimming, through the large territories of great Rivers and Seas.

The *Larynx* is framed of many Cartilages (as well as Muscles) the First called the *Epiglottis*, hath been discoursed already, the Second may be called the Buckler Cartilage, which beginneth narrow with a process, adorned with a semicircular Margent; on each side of this Process are adjoyned a wing, which is a broad Expansion ending in small Extremities, or Cones.

The middle of this Cartilage is most protuberant, and terminates into a thin semicircular Expansion.

Near the Buckler Cartilage, the *Cricoides*, or annular Grisse taketh its rise, which are tied to each other by the interposition of Membranes, and the annular Cartilage is near akin to that of Quadrupedes in Figure.

The Fourth and Fifth Cartilages, being conjoyned by Membranes, do constitute the *Arytenoides*, and the space of their partition is vulgarly called the *Glottis*, or *Rimula*.

The *Aspera Arteria* is very short in this Animal, as holding conformity to the Neck, which is endued with a small length, upon which account the *Trachea* is beset with a few annular Cartilages, which do not make perfect Circles as parted by the Interstices of Membranes: When the Windpipe entreth in the substance of the Lungs, it is divided into two Branches, and afterward into more numerous Divarications of the Bronchia.

The *Epiglottis* and *Glottis* of a Porpoise, conjoyned like the Bill of a Goose.

The description of the *Epiglottis* of a Porpoise.

The Surface of the *Epiglottis* is Convex as outward, and the inward is Concave. The conjunction of the *Epiglottis* to the *Glottis*, is made by a Membrane.

The *Glottis*.

The *Larynx* is a fine frame of Muscles, and Cartilages, &c.

The Cartilages of the *Larynx*.

The Buckler Cartilage.

The annular Cartilage.

The Fourth and Fifth Cartilage which do make the Hare-like Cartilage.

CHAP. XLIX.

Of the Winde-pipe of less perfect Animals.

The Trachea
of a Sea Tor-
toise.

The Carti-
lages of Ani-
mals are Cir-
cular.

The Trachea
of a Croco-
dile.

The Aspera
Arteria of a
Viper.
† T. 41. F. 1.
c c c.

The Aspera
Arteria of a
common
Snake.
† T. 41. F. 2.
c c c.

The Aspera
Arteria of a
Snake, called
Caprimulgus.

The Trachea
of a Silkworm
are numerous
which enter
into the Vis-
cera of the
middle and
lowest Apar-
timent.

THE *Aspera Arteria* of a Sea Tortoise, seemeth to have no *Larynx*, by reason the top of the Wind-pipe hath the same, or not much larger dimensions than the other parts of it, but in regard of its *Rimula* (commonly called the *Glottis*) though it be very small, yet it must be a part of the *Larynx*, as being a Fissure of the *Arytanoides*, where the two Cartilages are not conjoyned: And the *Aspera Arteria* is beset with many annular Cartilages, which are perfectly Circular as far as I could see in a Tortoise, Dissected by Learned Dr. Browne, at Mr. Hobb's House, in the presence of Renowned Dr. Whisler, and divers other Persons of Quality.

The *Trachea* of this Animal hath an equal bore, till it is divided into two branches, before it entreth into the body of the Lungs, which is rare in more perfect Animals.

The *Aspera Arteria* of a Crocodile, is very remarkable for its *Epiglottis*, as being very broad, and of a Semicircular Figure, filling up the Interstice of the Fauces; and the *Trachea* is beset with many annular Cartilages, making up complete Circles (as in a Sea Tortoise) without the interposition of any Membranous substance.

The *Aspera Arteria* of a Viper, is endued with a great length, and beset with numerous Cartilages, interspersed with Membranes, as in other Animals, and passeth over some part of the Stomach † (as Dissected in a Supine posture) and afterward creepeth under it, and then after a little space entreth into the Lungs.

The *Aspera Arteria* in an ordinary Snake, hath the structure of a Viper, and of other Animals, and maketh its progress all along the inside of the Spine †, and then creepeth under the Heart, and after small space is received into the Compag of the Lungs.

The *Larynx* of a Snake (called *Caprimulgus*) from the sucking the Teats of Goats) is rendred Conspicuous, as being exerted in the distortion of the Mouth; and the root of the Tongue being often vibrated near the head of the *Aspera Arteria*, maketh the hissing sound, when they are much surpris'd with fear.

The *Trachea* in this Animal is furnished with many Cartilaginous rings, which grow Membranous when they lean upon the Gullet, as it is found in most Animals.

Insects have a great *Apparatus* of *Trachea*, which transmit Air into most, if not all the *Viscera*, as most Ingenious *Malpighius* hath discovered in these admirable Minute Animals.

A Silkworm is furnished with a great company of Air-vessels, that every *Annulus* or Section of it is endued with a pair, and the sides all along the Body in length, are marked with many black spots, which are so many Orifices of *Trachea*, transmitting Air through various Pipes into the Heart, Stomach, Intestines, Spinal Marrow, and Bowels of the whole Body; So that the Concoction is not only performed in the Stomach and Intestines by Air conveyed by the Air-vessels, but the Spirit of Life and Motion is main-
tained

tained by Air, conveyed into the Heart and Muscular parts by *Trachææ*, which may be made good by this experiment of anointing the black Specks, the extremities of the Wind-pipes with Oyl, Butter, or any other unctuous Matter, which produceth Paralytick Indispositions and Convulsive motions, the forerunners of Death, caused by intercepting the current of Air into the noble parts, by stopping up the Orifices of the *Trachææ*, with clammy Liquor.

CHAP. L.

Of the Air-vessels of Plants.

V egetables have also somewhat analogous to the *Aspera Arteria*, and its various divarications in the Lungs, as they both have Organs instituted by Nature for the reception of Air, maturing the Blood in Animals and Sap in Plants, which containeth in it a principle of Life and Intestine motion, which are preserved and advanced by Air received into the Vessels of Vegetables, admitting in them, as well as Animals, great variety of situation, magnitude, and number.

In some Plants, near the inward confines of the Bark, in the lignous apartment, about the black circles of Sap-vessels, are seated many Pipes of Air, appearing sometimes in white bespotted rings; and other times the Air-vessels do clear up as short bright Rays within the clouded undulated rings of Sap-Cylinders; other times they appear in divers Columns, erected in straight lines, ascending the whole length of the body of Vegetables.

And also the Tubes of Air are lodged after a Conglomerated manner in a kind of Clusters in divers irregular postures, as being confusedly divaricated through the body of the Wood, without any distinct order.

The Air-vessels of Plants are also placed after the manner of Bends in an Escutcheon; So that besides those greater Tubes, that make the Ring, there are others less, which being seated in oblique lines do intersect each other.

In some Vegetables the Pipes of Air make many bars, passing aslant after the form of Fesses.

The Cylinders of Air do differ much in size, both in reference to each other in the same, as well as in different kind of Plants, and have much larger perforations than those of Sap-vessels, placed in the Wooden territories, but are much less than the Tubes of Sap, seated in the Bark; so that then divers kinds of Air-vessels (adorned with different magnitudes) as well as Cylinders of Sap.

And the Tubes of Air, besetting the wooden apartment, are not only different in size, but number too, in which they very much transcend one another in several Plants; So that it is admirable to view the great variety of Air-vessels, in situation, size, and number, which speak the wonderful Power and Wisdom of the Omnipotent Architect.

The structure of these Air-pipes, hath great affinity with those of Sap, and are oblong concave bodies, as a Contexture made up of many minute hollow Fibres, without any seam or unevenness.

Many Pipes of Air seated about the circles of Sap-vessels.

Air-vessels placed in irregular postures.

Air-vessels placed after the manner of Bends of an Escutcheon. The Pipes of Air do sometimes pass after the manner of Fesses.

The Tubes of Air seated in the wooden Compag of Plants.

The likeness of the Air and Sap-vessels.

Most

Most Ingenious *Malpighius* giveth this description of the Fabrick of Air-vessels, relating to Plants, that they are white flakes wreathed in Spires, and framed into Pipes, which adhere to each other like the Scales of Fish, and are hollowed into Tubes and Vesicles like the Lungs of Insects; and as in Humane Bodies and other less perfect Animals, the Wind-pipe without the Lungs, is dressed with a number of Cartilaginous rings, united to each other by the mediation of Membranes interspersed with fine fleshy Fibres; and when the Wind-pipe entrench into the body of the Lungs, it is divested of its grisly Circles, and groweth wholly Membranous as it is branched into numerous small Tubes, out of which an innumerable company of Vesicles are successively filled with, and emptied of Air in Inspiration and Expiration.

The Air-pipes are fastned to each other like so many Globules, and consist of a company of Spiral flakes.

These Membranous Cylinders of Air are accompanied with divers Globules fastned to each other like so many Scales lodged one below another.

And in like manner in Vegetables, we may discover by the help of Glasses, instead of Cartilaginous rings, a company of Spiral Flakes, beset with Tubes big with Air; and when the Trunks and Arms of Trees are waved up and down with boisterous blasts of Wind, the Air, confined within its proper Channels, is liable to brisk agitations, heightening its common Elastick motion.

The progress of the Air-pipes.

These Air-pipes in Plants do not pass Horizontally the breadth of the Trunk and Limbs, but ascend almost Perpendicularly in straight lines from the Root to the Trunk and Arms, and being carried into the lesser Branches and Leaves, do make great Mæanders and Plexes in the manner of Network.

Lignous Protuberancies which do encircle the Pipes of Air.

In some trunks of Trees adjoyning to the Roots, may be discerned several thin lignous Prominencies (which encircle the Pipes of Air, in which they are lodged as so many Repositories) having variety of magnitudes; some seem to be a System compounded of many Tubes, and the Vessels of Air sometimes pass horizontally through these Protuberancies; whose fruitful Branches are beautified with several Cells wreathed with divers Spires.

The manner of Nutrition in Plants.

Plants being animated with a principle of Life, have their lower region dwelling in the bowels of the Earth, wherein they borrow the Matter of their Aliment from Water (filtered through the Crannies of the Earth, and associated with Air, and impregnated with steams floating in the lower Orb,) which is conveyed through the Pores of the Bark, investing the Root, into the Vessels of Sap residing in the Bark; whereupon Sap, inspired with airy Particles, doth fill and distend its proper territories.

The Sap-vessels hold an intercourse with those of Air.

And as Men and other less perfect Animals, are bedewed with Lacteal Liquor inspired with Air, in the Stomach and Intestines, and Blood exalted with Air in the Lungs, and Nervous Liquor improved by it in the Cortex of the Brain; so in like manner the Sap-vessels of Plants, containing divers milky, gummy, resinous, and aqueous Liquors, do hold an intercourse with Pipes of Air, which discharge themselves by numerous Extremities into several Tubes, conserving these different Juices much advanced by Air, impregnated with æthereal Particles and variety of *Effluvia*, enobled with Volatil Saline and sulphureous Particles, rendring these Liquors more fluid and apt for motion, much quickned by the active parts of Air, which do not only enter by the Pores of the Bark relating to the Roots of Vegetables, but also by the small *Meatus* of the Rine, encircling their Trunks, Arms, and lesser Branches. And herein Plants do hold some analogy with Animals, through whose Pores of the Skin the Air insinuates through the Extremities and

and Channels of the Veins into the more inward Recesses of the Body. And somewhat after this manner the Air being conveyed through the minute passages of the Bark into the more inward penetals of Plants, doth not only contribute to the Local, but Intestine motion too of several alimentary Liquors, as they are receptive of Fermentative dispositions, chiefly imparted to them from airy Particles heightened with Celestial Emanations consisting of Heterogeneous Elements, which being embodied with the Sap of Vegetables, do put it into motion, proceeding from contrary principles, as so many Combatants endeavouring by various brisk actions to gain a Conquest upon each other (for their mutual advantage of greater maturity and perfection) ending in a happy reconciliation of their disagreeing Natures.

Hence the more spirituous and more volatil steams of Air, being espoused to the more gross and fixed parts of Sap, do attenuate and refine it, and by imparting more active dispositions do render it more fluid, generous, alimentary, and fruitful, which are very much propagated from Air, not only impregnated with *Effluvia*, transpiring the Pores of the triple Family of Minerals, Vegetables, and Animals, but are also exalted with more noble qualities flowing from Celestial Bodies, whose warm and benign influences do make the Air more nimble and spirituous; which being embodied with the Sap of Plants, do give them nourishment, growth, and propagation, by whose vertue they sprout, blossom, bear Fruit and Seeds, as so many pledges of a farther production and duration, in which Nature is Emulous of Eternity by a kind of resurrection from Death to Life.

The use of the
Air-vessels.

B 10

CHAP.

C H A P. LI.

Of Respiration.

Nature hath seated the Lungs near the Heart, in the sacred and inward Recesses of the middle apartment, as remote from our eyes, as understanding, and it might be wished that our Breast had been made transparent, that we might have a clear prospect of its secret Intrals, and understand the nature of Respiration, the end and perfection of this noble engine of Air, and the great Preservative of Life.

To give a History of Respiration, it supposeth its efficient cause productive of it; Secondly the Organs, Thirdly the manner how it is celebrated, and the Fourth is the Use of it.

The efficient
cause of Re-
spiration.

The efficient cause is the motive faculty, by which this noble operation is accomplished, proceeding originally from the Animal Liquor generated in the Cortex of the Brain, conveyed by Nerves into the Intercostal Muscles and Diaphragm, and into the Lungs too; Some hold, the operation of Respiration to be Natural, others Animal, and a third, a mixed action.

The nature of
Respiration
in reference
to its action.

Learned Diemerbroeck is of an opinion, that the motion of Respiration is merely animal. *Anatomes lib. 2. de Thorace, p. 532. Ait ille de isto Respirationis motu inter Philosophos agitur quæstio, scilicet qualisnam sit actio: Quippe alii naturalem, alii animale, alii mixtam ex naturali & animali esse tradunt, suasque opiniones singuli plurimis rationibus confirmant, quas omnes hoc referre nimis longum foret. Ex modo dictis satis liquet respirationem esse actionem mere animale, quia peragitur motui animali inservientibus instrumentis, scilicet Musculis, & pro arbitrio nostro potest accelerari, tardari, intendi & remitti, ut videmus in Cantoribus, Tubicinibus, aliisque & quilibet in seipso experitur: immo etiam ad mortem usque cohiberi potest in iis, qui mori non timent; Cujus exemplum habet Galenus, lib. 2. de motu Musculorum. Cap. 6. De Seruo barbaro, qui respiratione cohibita sibi mortem conscivit:* The great difficulty that perplexeth this opinion, is, because this necessary motion made for the preservation of our Life, is not merely arbitrary, as being celebrated for the most part without the command of the Will, by a kind of natural action, as it is wholly found in time of repose, when we have not the least apprehension of the motion of the Thorax, Diaphragm, or Lungs, which seem to hold great similitude with that of the Heart, in the time of rest, as all these different Engines of Motion are acted without the least dictate of the Will.

The Organs
of Respiration.

The Organs of Respiration, are first the Intercostal Muscles, the arched Ribs, Sternon, and Diaphragm, as antecedent to it; and the Lungs are the immediate machine, whose different motion doth constitute the various kinds of Respiration.

The Intercostal Muscles are lodged between the Ribs, and do begin and end in their several Tendons, implanted into the upper and lower margin of the Ribs; these long slender Organs of Motion, have many fleshy Fibres decussating each other, and being contracted, do lift the Ribs upward and outward.

The Inter-
costal Muscles
do contribute
to Respiration.

It is a received opinion, that the outward Intercostal Muscles are ministerial to the Dilatation, and the inward to the contraction of the Thorax; but,

as

as I humbly conceive, it is no reason, that both the outward and inward Intercoſtal Muſcles do aſſiſt each other in the dilatation of the *Thorax*, by reaſon the Ribs elevated in order to Reſpiration, need no Muſcles to deprefs and reſtore them to their former poſture, which they obtain of themſelves, *actu quodam reſiliendi*, which is agreeable to any ſolid body when it is drawn by ſome outward principle beyond its own natural ſituation.

And moreover it is reaſonable to affirm, that the Ribs being moved upward and outward, do dilate the *Thorax*, and being pulled downward, do narrow the cavity of the Breſt.

The Ribs being moved, do dilate the *Thorax*.

And it is very evident to any intelligible Perſon that hath curiouſly inſpected a Skeleton, that the Ribs (eſpecially the lower ones) are moſt conducive to the dilatation of the *Thorax*, and are not articulated with the Spine and Sternon, according to exact right angles; So that if the Ribs be elevated upward and outward by the motion of the Intercoſtal Muſcles, that then the Ribs do quit ſomewhat of their Semicircular Figure, and come nearer to right angles, in reference to their articulation with the Spine and Sternon.

Farthermore it may be conceived, that the Ribs being liſted up to right angles, that the Cavity of the *Thorax* is enlarged; but if we ſuppoſe divers arches to be placed upon a Plain, the ſpace interceding them, cannot be great, becauſe they make near approaches to each other in point of ſituation; but if theſe arches be liſted up ſomewhat above a Plain, a ſpace muſt neceſſarily paſs between them, and the nearer theſe arches do come to right angles, the *Sinus*, or empty ſpaces, running between them muſt be ſo much the greater: And let us borrow an inſtance from the Breſt, in reference to the Spine, Sternon, and Ribs; So that the Plain interceding the Spine and Sternon, is the Mediſtine, or any other imaginary Plain, dividing the *Thorax*, into equal parts; wherefore the arched Ribs upon the Plain (or which is the ſame, upon the Spine, and Sternon placed upon the ſame Plain) do riſe toward right Angles by the contraction of the Intercoſtal Muſcles, the ſpace muſt be more enlarged, paſſing between the elevated Ribs, and the Mediſtine.

As to the lower or baſtard Ribs, though their Terminations are not affixed to the Sternon, but Diaphragm, yet they participate the ſame motion with the other Ribs, and do alſo dilate the *Thorax*; ſo that any man may experiment in himſelf that in Inſpiration, the Ribs are drawn upward and come outward toward right Angles; and in Expiration, when the Intercoſtal Muſcles are relaxed, the Ribs do deſcend, and receive their former Semicircular Figure, and the *Thorax* is reduced to its Priſtine more narrow Perimeter.

And not only the external Intercoſtal Muſcles (as ſome imagine) but the Internal too do contribute to the dilatation of the *Thorax*, by reaſon both kinds of Muſcles have their Extremities implanted into the margents of the next upper and lower Rib; whereupon the moſt looſely faſtned, doth approach the more ſtrongly, by the contraction of the Intercoſtal Muſcles; wherefore the lower Rib having a more lax articulation than the upper, muſt neceſſarily be drawn upward by the motion of the Muſcles, toward the upper more fixed Rib, as to the Center of Motion; whence it may be reaſonably deduced, that both the External and Internal Intercoſtal Muſcles, though they have different inſertions into the Ribs, yet in their contractions they aſſiſt each other at the ſame time to liſt the Ribs upward toward the Throat; and furthermore theſe Ribs are articulated in ſuch fit poſitions, that the Ribs may receive an elevation for the joynt motion of the Intercoſtal Muſcles, ſeat-

The Internal as well as External Intercoſtals are miſſerial to Reſpiration.

ed

ed between the confines of the neighbouring upper and lower Rib.

And this *Hypothesis* may be farther proved by the oblique and contrary situation of the Intercostal Muscles, which hath been contrived by Nature, that the Muscles being inserted into the confining Ribs in an oblique position, may have a greater power to contract themselves, to raise up the Ribs; and again the Interstices of the Ribs are so small, that if these Muscles should be inserted in right angles, they would be too short to do the work conferred upon them by Nature; wherefore that the Intercostal Muscles may be endued with a proper length, they are obliquely implanted into the sides of the adjacent Ribs, which by reason of an oblique insertion of the Muscles is not fit to carry the Ribs upward, as to incline them outward, or inward; therefore the grand Architect hath most wisely contrived the divers situations of the External and Internal Intercostal Muscles, that both pulling obliquely with equal force, might mutually concur to the carrying Ribs upward; by reason the Ribs are so seated in the articulations with the Spine, that they are more easily drawn toward the higher than lower region of the *Thorax*, whereupon its Cavity is enlarged in order to give reception to the enlarged Lungs, dilated by Air in Inspiration.

The various
Articulations
of the Ribs.

And it is worthy our remark, that the Ribs have not only one, as is commonly thought, but two Articulations, discovered by Learned Dr. Mayow, in his Treatise de Respiratione, p. 284. *Advertendum est hic loci, quod Costæ non unicâ, uti vulgo creditur, sed duplici articulatione cum Spina conjungantur: Articuliq; isti adeo oblique collocantur, taliq; artificio formentur, ut Costæ à Musculis Intercostalibus sursum trahi nequeant, quin eadem simul extrorsum pro majori pectoris dilatatione trahuntur: Quum caput Costæ sit rotundum, ut sinum in Spina excavatum ingrediatur, quæ Articulatio superior & interior est. E contra vero in Articulatione altera, sc. inferiori, & interiori sinus, is autem minus conspicuus in Costa excavatur, qui cum protuberantia Spinae, articulatur. Jam vero supponamus Caput Costæ istius in cavitate Spinae collocari, & sinum Costæ protuberantiæ Spinae incumbere, & dein Costam eam, binis istis Articulationibus Spinae connexam, sursum moveri; facile est conceptu, Costam eam ad lævam, sive quod idem est, respectu pectoris extrorsum latum iri.*

And it hath been farther observed by this Learned Author, that this said articulation of the Ribs with the Spine, and their oblique posture is more eminent in other Animals, which are liable to violent progressive motions, and thereupon require higher Respiration, and a more great dilatation of the *Thorax*. *At ille, Prædictæ Articulationes, uti etiam eadem obliquitas in Sceletto Ovino, Equino, quam in Humano magis manifestæ sint; Etenim annotare est, quod Articulationes istæ in aliquibus Animalibus, quæ multo magis, quam in aliis obliquæ sint: Nempe Animalia, quæ exercitiis violentioribus dicata, Respiratione intensiori opus habent, iis Costarum Articuli valde obliqui sunt, quod vid. eorum Costæ per Musculorum Intercostalium contractionem magis extrorsum ducantur, spatiumq; in thorace pro pulmonibus late explicandis satis amplum aperiatur.*

The oblique
insertion of
the Cartilages
into the Ribs.

And it may be farther observed, that the Cartilages of the Ribs, by whose interposition the Ribs are conjoyned to the Sternon, are inserted into the Ribs with an eminent obliquity, which is wisely framed by Nature, that the Ribs might be carried outward in their extension, made by the mutual contraction of the External and Internal Intercostal Muscles, to render the Cavity of the *Thorax* more large in Inspiration; in which the extremities of the bastard Ribs have a contrary position, as being drawn inward, in a difficulty of breathing, which is caused by reason the termination of these Ribs are tied to the fleshy circumference of the Diaphragm, which being violently contracted,

tracted, doth draw the neighbouring extremities of the lower Ribs inward, which are restored to their natural position upon the relaxation of the Diaphragm.

Having treated of the Intercoastal Muscles, Ribs, and Sternon, being part of the Organs of Respiration, as ambulatory to it; another as requisite as any of the other, may be offered to our consideration, and is the Midriff, whose contraction doth concur with the foresaid to the enlargement of the Breast, to give reception to the Lungs, distended with Air in the act of Inspiration.

The Diaphragm seems to be acted with a double motion, the Diastole and Systole; but the first, as I humbly conceive, is rather a relaxation of its motion, when the Fibres, formerly made tense by Contraction, are relaxed, and the cavity of the *Thorax* rendered narrow, when the Diaphragm in its state of restitution is brought unto an Arch, having its upper surface, looking toward the Heart Convex, and Concave toward the Stomach and Intestines, whereby the Lungs are compressed, and the Stomach and Guts are set at liberty, as ascending upward into the cavity of the *Thorax* toward the concave surface of the Midriff.

The double motion of the Diaphragm as some imagine, which in truth is but one.

In the Systole, which is the true motion of the Diaphragm, it is pressed downward, and quitteth its arched position, and is brought very much toward a Plain, and the *Viscera* of the lowest Apartment lodged within its Concave walls, are beaten downward and outward, whereupon the Cavity of the *Thorax* becometh much enlarged, as acquiring greater dimensions of length, to entertain the dilated Compag of the Lungs when rendered big with Air.

The Systole is the true motion of the Diaphragm, wherein it is brought to a Plain.

The most proper and principal Organ of Respiration, are the Lungs, as a Machine, in which the Air sporteth it self in and out in various motions, productive of Inspiration and Expiration.

In the first the stream of Air is received, either through the Nostrils, or immediately through the Mouth into the greater Channel of the Wind-pipe, and afterward into the Branches of the *Bronchia*, as so many smaller Pipes, and from thence into the numerous Membranous *Sinus*, as so many Out-lets of the *Bronchia*, interspersing the Lobules with white Interstices; whereupon this fine spongy Compag, made up of different Cylinders and membranous Orbs, groweth highly expanded with thin, spirituous, and Elastick Particles of Air.

In Expiration the Air maketh its retrograde motion out of the Lungs, as the receptacles of Air are compressed by the Ribs, Diaphragm, and weight of the Lungs, whereupon the numerous small Tubes of Air and their appendant *Sinus* grow lank, as being lessened also by straight and circular Fibres, contracting the Cavities of the fruitful Cylinders and Orbs of Air; so that in Expiration it is squeezed out of the smaller Pipes into a greater Tube, and so into the larger Portal of the Mouth, and afterward confederates with the outward Air, as coming from it, and being near akin to it in its fluid temper.

And let us admire and adore with Joy and Eucharist, the wondrous contrivance of the Great Architect, who hath framed in infinite Power and unspeakable Wisdom, the excellent Oeconomy of Nature, as made up of variety of Noble parts, disposed in excellent order.

The Body of Man (the rule and standard from which all the Bodies of other Animals take their measures) may be called an *ανπματον*, a kind of Watch or Clock, consisting of numerous Wheels, moved by variety of Springs, as

those Wheels of the Gullet, Stomach, Intestines, Arteries, and Muscles, the greater and stronger engines of Motion are all contracted by Flethy Fibers, acted by the Elastick Particles of Animal Spirits, the more refined Atomes of Nervous Liquor.

And the Oeconomy of the Vital parts, the Heart and Lungs seated in the middle Story of Mans Body, hath a kind of peculiar Oeconomy somewhat different from that of the other parts of the Body, as the Lungs) a great machine of Motion) are chiefly managed by an external principle by the spring of Air, distending its curious Frame, consisting of many Cylinders and Orbicular Tunics, as so many Channels and Cisterns of Air.

And having taken the little Clock (composed of many Respiring Organs) in pieces, and treated singly of every Wheel; of the Intercostal Muscles, and Semicircles of Ribs, how they are affixed to the column of the Spine, and Sternon, and of the Circular Diaphragm, and of the Lungs, as the great Wheel of Life, to whose motion all other lesser Wheels are assistant; I will now set all these Wheels together, and endeavour to shew you the reason and manner of Respiration, which is a thing of as great Difficulty, as Importance.

The several parts concerned in the motion of the Lungs.

The Intercostal Muscles.

In the order of Nature the motion of the Lungs is first designed as its chief Machine, made up of various Receptacles of Air, but in point of Time, this great, and other lesser Wheels do celebrate their motions together.

At the same instant the Intercostal Muscles, Arched Ribs, Sternon, Diaphragm, are engaged in various motions, contributing to the main motion of the Lungs.

The two ranks of Semi-Elliptick Arches of the Ribs, seated in both sides, have two Extremities, the hinder are obliquely fastned in a double movable Articulation with strong Ligaments to the Spine (curiously Carved with variety of acute, oblique, and transvers Processes) as to a firm immovable Column; The anterior grisly Terminations of many of the Bony Arches, are conjoyned in oblique lax Positions to the Sternon (as to a Breast-plate;) So that these extremities of the Ribs may be dilated with the Sternon, annexed to them.

These are called Parallel Bony Semicircles, because they observe an equal distance from each other, as interspersed with the Intercostal Muscles, being thin oblong quadrangular Bodies, consisting of a kind of Parallelogramms in Figure.

The Intercostal Muscles, seated between, and affixed to the Ribs in oblique Positions, consist of two Ranks, the one External, the other Internal, which are furnished with numerous equidistant Fibres, intersecting each other.

The double row of Fibres besetting the Intercostal Muscles.

The double row of Fibres besetting the Intercostal Muscles, was wisely instituted by Nature upon this account, to assist each other at sometime in a concurrent motion, by reason two ranks of oblique Fibres would else distort the Ribs in the motion of the Breast; For instance, Suppose the Ribs, being parallel with each other in point of Concave Surface, it may seem evident, when the oblique Fibres are shortned, it will disorder the equidistant posture of the Ribs, if the different oblique Fibres of several Muscles should move the Ribs in various inward and outward Positions at the same time.

Therefore it is prudently contrived by Nature, that all the Fibres decussating each other, and affixed to the Margents of the Ribs, should jointly produce the same operation of moving them upward and outward at the same time.

To

To give a more clear sight of the manner of Breathing, I will improve my utmost endeavours to shew you all the Instruments of Respiration moving together, as serving each other in a great order and decorum, sometimes enlarging the Perimeter of the *Thorax*, to give the distended Lungs a free play upon the reception of Air, and another time to contract the circumference of the Breast to exclude its effæte reliques in Expiration.

The manner
of Respiration.

When the free streams of Air run through the larger Channel of the *Aspera Arteria*, into the lesser Pipes of the *Bronchia* and its appendant round Tunicles, the spongy substance of the Lungs groweth swelled, acquiring greater dimensions, whereupon the neighbouring parts give way at the same moment for its more easie reception, the Midriff contracteth it self by various Fibres, and is brought to less and less Arches, till it arrives a kind of Circular Plain; So that the Stomach, Intestines, and Liver, lately entertained into its arched bosom, in the *Thorax*, are now depressed into the lowest apartment, whereby the Perimeter of the middle Story is much lengthened, to give a free entertainment to the greater dimensions of the Lungs, and not only the Midriff hath quitted its Convex Position toward the Lungs; and Concave toward the *Viscera* of the lowest Story, but the Ribs at the same instant lose somewhat of their Arches too, because they being tied to the Spine (as a fixed Column, the Center of Motion) are pulled upward and outward; by reason their Articulations are so framed with the Vertebres of the Back, that they may give way to the contractions of the Intercoastal Muscles, bringing their inward Concave Surfaces to a Plain, thereby making acute Angles, whereupon the Ribs being brought in a Perpendicular toward the Neck, and more horizontally toward the Back, the Perimeter of the *Thorax* becometh greater in breadth, as a more easie allodgment for the tumefied Lungs in Inspiration.

The enlarged
dimensions of
the *Thorax* in
Inspiration.

In Expiration the contracted Abdominal Muscles force up the Liver, Intestines, and Stomach into the bosom of the Midriff, which is thereby relaxed, as having its Circular Plain reduced to an Arch, and at the same time the decussated Fibres of the Intercoastal Muscles being unbent in their repose, the Ribs are brought downward and inward, *actu quodam resiliendi*, (as hard Bodies) from acute to obtuse Angles, whereby the Perimeter of the *Thorax* is narrowed at the same moment in latitude by their arched Ribs, as well as lessened in longitude by the Convex Surface of the Midriff; So that the Lobes of the Lungs are horizontally and perpendicularly compressed, and the Membranous *Sinus*, and numerous Pipes, discharge the Effæte remains of Air (not associated with the Blood) into the greater Pipe, the *Aspera Arteria*, and thence into the Mouth.

The circumference of the
Breast is narrowed in
Respiration.

And I humbly conceive, that the Orbicular Tunicles, and the numerous smaller and greater Cylinders of Air, are not only emptied by the compression of the Convex Surface of the Midriff, and the Arches of the Ribs brought to obtuse Angles, but also by the motion of the right and circular Flethy Fibres, contracting the Cavity of the Membranous Orbs, and various Cylinders; whereby the Air is squeezed out of them into the larger receptacle of the Wind-pipe.

The Lungs are
emptied in
Expiration.

In short, Inspiration is made by all the Organs moving the same time, while the Lungs are distended by the inflation of Air, the arches of the Ribs are brought from obtuse to more acute Angles, and the Concave Surface of the Midriff to a plain circular Position, to give reception to the greater dimensions of the expanded Lungs.

In

In Expiration the lately distended Lungs grow soft and lank, as their many round Concave *Sinus* and Tubes of the *Bronchia* are disburdened of Air by a compression made by the recoyling of the Ribs, brought from acute to obtuse Angles, and from the Midriff forced upward by the contracted Abdominal Muscles, throwing the *Viscera* of the lowest Story into the bosom of the Diaphragm, whereby the Perimeter of the *Thorax* is lessened, and the Lungs compressed to expell the Effate reliques of Air, with the unprofitable steams of the Blood.

Having Mechanically described the motion of the Ribs, Sternon, and Midriff, as instruments of Respiration, the great difficulty remaineth, which doth highly perplex us, how the Lungs, the curious Machine of Air, and great Organ of Breathing do move, which is most worthy our remark and deep inquiry.

The Lungs have no inward principle of Motion.

The Lungs being a fine Compage of various parts, have no Internal principle of Motion, as not being furnished with any Muscles or Muscular Fibres, which are the machines consigned by Nature to the production of Local motion; neither are the Lungs fastned to any neighbouring Muscles, as the Intercoastal, and Diaphragm, the one moving the Ribs, and the other it self, to enlarge the circumference of the *Thorax*, to give reception to the greater bulk of the expanded Lungs.

The Lungs are destitute of Flethy Fibres.

Whereupon this noble Mechanism having no Muscles, nor fleshy Fibres (which hold some analogy with them) borroweth its motion from some External Principle, from the fluid and elastick parts of Air, expanding the rare and tensive Compage of the Lungs, as composed of membranous Cylinders and Orbicular Tunicles.

The different parts of Breathing produce Inspiration, making the Diastole of the Lungs, caused by the inflation of Air, and the Systole, acted by the contraction of the Lungs, ejecting Air out of its Concave Receptacles.

The Systole and Diastole of the Lungs do not keep time with the pulsation of the Heart.

These different repeated motions of the Lungs do not keep time with the Diastole and Systole of the Heart, but have different pauses and intervals of motion, as the dilatation and contraction of the Lungs, are acted with more slowness, quickness, or magnitude, as subject to the dictates of the Understanding, and commands of the Will, to which the meerly natural motions of the Heart are in no manner liable, by reason the Heart maketh its constant uninterrupted Pulsations, when the Lungs for some time do suppress their several motions in obedience to the commands of the Will.

Again, many Pulsations are celebrated in the Heart, while the Lungs have but one Diastole and Systole, as any may easily experience in himself, as comparing the pulsations of the Artery (observed by a touch of his Finger in his Arm) with the Diastole and Systole of the Lungs, the expansion and contraction of them made in Inspiration and Expiration, by the immision and emission of Air into and from the *Bronchia* and *Sinus* of the Lungs.

The Matter and external efficient cause of Respiration.

Farthermore, the matter and external efficient cause of Respiration in terrestrial and flying Animals, are the elastick particles of Air, and cannot be the more gross fluid parts of Water, which being immitted into the *Bronchia* of the Lungs, will immediately confound the different motions of Respiration, and produce Suffocation, which is very conspicuous in drowned Animals.

And it is also requisite in Air, that it should have a moderate consistence, by reason if it be too thick, as mingled with gross Vapours, coming out of stagnant

stagnant Waters ; or ill Minerals of the Earth, it will produce first a difficulty of Breathing, and afterwards Suffocation, or at least a loss of Breath, found upon the expiration of Animals, long living in gross or corrupt Air.

If we make an Inspection into the motion of the parts exercised in Respiration, we may easily experiment in our selves, that the Air is immitted through the Mouth into the greater and less Cylinders of the *Bronchia*, and their Orbicular Appendages, whereupon the whole Compag of the Lungs, is blown up like a Bladder, or like Bellows, whose concave Leathers are dilated by Air, much resembling the expansion of the Lungs in Inspiration ; This may be made manifest to our Eye after the Dissection of one or more Intercoastal Muscles, wherein part of the *Thorax* being opened, a Lobe of the Lungs may be handled, and found hard and tense, as distended with numerous particles of Air insinuated into the greater and less Pipes of the Lungs.

The Air is immitted into the Lungs in Inspiration.

And also in a fleaed Animal alive, we may view how much the Perimeter of the Breast is enlarged in breadth by the Ribs, (brought from obtuse to right Angles, effected by the contracted Intercoastal Muscles,) and much in length, when the Midriff is drawn by its Flethy Fibres from an Arch, to a circular Plain.

The Perimeter of the Breast is enlarged in Inspiration.

Learned *Borellus* giveth an account mechanically in his second Book *de Motu Animalium*, p. 163. how much the circumference of the Breast is enlarged in Inspiration, by taking a Glass Cylinder of Fifty Foot long, and the Diameter of its Bore was somewhat greater than the fourth part of a Fingers breadth ; whereupon part of its Cavity might be filled with a Fluid, containing fourteen Cubick Digits ; after the Orifice of the Cylinder being put into a Saucer full of Soap Suds, and took a little part of the clammy Liquor into the base of the Cylinder, somewhat resembling the Cylindrick bottom of the Breast covered with the Midriff, and afterward his Nostrils being stopped, and the upper Orifice of the Cylinder being applied to his Mouth, he sucked out of its Cavity such a proportion of Air, as his Lungs did usually receive in one gentle Inspiration, in the interim the watry liquor did not ascend to his Lips ; whence it may be inferred, That the quantity of Air received at one breath into the Pipes of the Lungs, was not equivalent to Fourteen Cubick Digits, by reason some part of the cavity of the Cylinder, containing the said Digits, was filled partly with remanent Air, and partly with Water received lately into the base of the Cylinder.

Borellus his Experiment to shew how much the breast is enlarged in Inspiration.

And to give you a more full History of this Experiment, I will make bold to trouble you with the Renowned Author's own words, least I should do him some prejudice in the Translation. *Ait ille, Quanta vero sit ampliatio Thoracis facta ab aeris inspiratione haberi potest hoc artificio ; Sumpsi Fistulam vitream Cylindricam, cujus longitudo 12 Digitos aequabat, & basis, seu cavitatis diameter quadrante digiti unius paulo major erat. Quare capacitas ejus repleti poterat à fluido 14. Digitorum Cubicorum ; postea immerso Orificio fistulae intra scutellam Saponis lotura repletam, excepi exiguum aquae viscidae portiunculam, quae replebat infimam basim fistulae ad instar Diaphragmatis. Naribus deinde constrictis, applicato ore exuxi ex vitrea fistula tantam molem aeris, quantam unica leni Inspiratione Pulmones excipere solent ; & tunc aquea illa gutta elevata, ad os non pervenit. Hinc deduxi quod moles aeris à me Inspirati 14 Digitos Cubicos non aequabat ; sed supponamus fuisse quindecim postea, quia mei thoracis amplitudo, seu Diameter 15 Digitos non aequat, erit proxima moles Sphaeroidalis compressa mei thoracis aequalis 3375 Digitis Cubicis, quare post Inspirationem additis*

15 aliis Digitis Cubicis aeris & molis aucta thoracis æqualis 3390, Digitis Cubicis, & hujus radix Cubica est 1550; Ergo intrusio aeris Inspirati auxit Diametrum mei thoracis non amplius, quam una quinquagesima parte crassitie unius Digiti.

Whereupon he addeth the motion of the Breast to be obscure in Inspiration, by reason a small elevation of the Sternon toward the Neck can only be discerned, and the Abdomen being opened, the Midriff may be discovered to be brought from a Concave Surface to a Plain in a gentle Inspiration, because in a violent one the *Thorax* is more dilated, as receiving a double proportion of Air, more than is admitted in a quiet breathing.

The ambient Air is forced into the Lungs by the weight of the superincumbent Atmosphere.

The great difficulty is yet unsolved, how the Air is immitted through the greater and lesser Channels into the spongy compage of the Lungs, making its *Dia stole* in Inspiration. Some conceive that Air being a fluid body, hath a power to protrude one part after another; so that the ambient Air is forced through the Nostrils or Mouth into the *Aspera Arteria*, and smaller Pipes, into the Orbicular Tunicles, and thereby raiseth the body of the Lungs, by reason the Air by virtue of the weight of the superincumbent Atmosphere doth not only rush into the empty spaces of Pipes, but strongly presseth through the neighbouring parts endued with round concave Surfaces, receptive of this movable body of Air; which is continued from the circumference of the Body to the greater and smaller Tubes and Orbicular *Sinus*; So that the motion of Air is favoured by the insides of the *Thorax* (which before did resist the pressure of Air by compression) as dilated by the Intercostal Muscles, whence a freedom is given to the motion of the ambient Air pressed forward by the weight of the Atmosphere into the Cavities of the numerous Pipes, relating to the Lungs.

The structure of the Lungs contributeth much to Respiration.

The structure of the Lungs much contributeth to the motion of this fluid Body, as it is composed of greater and less Tubes leading into appendant Orbicular *Sinus*, affixed to the sides of the *Bronchia*, whereby the Air hath a free access into these numerous Pipes and *Sinus*, enlarging the bulk of the Lungs in their *Dia stole*.

The Elastick force of Air assisteth the inflation of the Lungs.

And not only the pressure of the Atmosphere, but the elastick force of the Air, as having inclinations immensely to extend it self, do much promote the inflation of the various Cylinders and Orbicular Tunicles; by reason the power, by which the compressed Air doth endeavour to expand it self, is equal to the pressure of the Atmosphere, which being more intense or remiss, doth impart greater or less Elasticity to the Air; So that its Elastick power (as I humbly conceive) doth arise from hence, That the nearer it is to the Globe of Earth, it is the more compressed by the weight of the superincumbent Air, whereupon it groweth more Elastick as it hath a natural endeavour to dilate it self to take off its confinement, caused by many superior Columns of Air resting upon its ambient parts, encircling the Earth; and when the ambient Air near this Globe is compressed by the weight of its innumerable parts leaning upon its lowest region, it hath a natural proneness to free it self from pressure, by expanding it self with a motion of restitution; as it may be made evident by a known Experiment, *vid.* if a Bladder having the greatest part of Air taken out of it by compressing, and afterward a stronger Ligature being made in the Neck, and then the Bladder be placed in the Glass, (out of which the Air is afterward drawn out) whereupon the Bladder will presently swell, and be highly blown up, which is pleasant to behold, by reason the Air, though very little, is confined within the Bladder, and the external Air (by whose pressure it was brought into a narrow compass)

compass) being withdrawn, doth immediately dilate it self, and blow up the Bladder: After this manner it may be conceived that the inflation of the Lungs is accomplished, because as soon as the sides of the *Thorax* (which compress the Lungs in their contraction) are drawn upward and outward, the ambient Air, confining on the entrance of the Wind-pipe, is impelled by the pressure of the Atmosphere, and by its own Elastick power into the greater and lesser Pipes, and round *Sinus* of the Lungs, whereby they grow immediately distended.

Learned Dr. Mayow, doth illustrate the inflation of the Lungs in Inspiration by another Experiment, in which a Bladder, being included within the cavity of the Bellows, with this contrivance, that the neck of the Bladder may be so fastned to the inside of its nosel, that the Air received by it, be immirted into the body of the Bladder; So that the Bellows being opened, the Air will immediately rush into the Bladder, lodged in the body of the Bellows, which the Ingenious Author conceiveth to resemble the distention of the Lungs in their Diastole, as it may be read in his Treatise of Respiration, p. 274. *Supponamus ergo Vesicam in cavitate Follis inclusam, ejusdemq; collum rostro Follis sibi indito, ita affixum esse, ut aer rostro ei inflatus, non nisi in vesicam dictam transire possit, ut autem illud fiat, vesica ista rostro Follis eo modo adaptanda est, cum Follis iste nondum compaginatur: Porro foramen, illud vero non, uti assolet, in inferiore lamina Follis, sed in superiore jam, idque satis amplum excudatur; idemq; vitro ope cæmenti idonei lamina ei affixo strictim obturetur; quo vesica intus inclusa, per vitrum istoc, tanquam per fenestram conspici possit. His ad hunc modum paratis, si Follis iste aperiatur, illius laminas ab invicem diducendo, vesicam dictam intumescere, & in cavitatem Follis ampliatam extendi percipies; & quidem eadem plane ratione Pulmonum inflatio in pectore dilatato efficitur.*

Dr. Mayow's Experiment about the inflation of the Lungs.

Both these Experiments, the one being performed by the reception of Air into a Bladder (placed in a Glass) and the other in Bellows, do seem to prove the motion of the Air into the *Aspera Arteria*, and its Branches, (divaricated through the body of the Lungs) made by the pressure of the Atmosphere, and the elastick parts of Air.

Some Learned Anatomists have this sentiment, That the inflation of the Lungs in Inspiration is not performed wholly by the weight of the superincumbent Air, but by the attraction of it through the Nostrils or Mouth into the Wind-pipe and its smaller Tubes, and their appendant *Sinus*, after the manner of sucking Water through a Pipe or Quill into it; whereupon one extremity of the Pipe being put into the Mouth, and the other into Water, the ambient Air is wholly secluded from its access to the Pipe, which causeth the Water, by the power of the breath drawn inward, to ascend through the Pipe into the Mouth, to preserve the Oeconomy of Nature by avoiding a vacuity which would ensue, when the Air, lodged in the cavity of the Pipe, is gradually exhausted, if the Water did not rise up by degrees, and supply its place in the Pipe. After this manner it may seem the Air is drawn into the Wind-pipe, and its smaller Branches lodged in the Lungs, to prevent a *Vacuum*, when the Perimeter of the *Thorax* is enlarged by the motion of the Intercoastal Muscles, bringing the Ribs upward and outward from obtuse to somewhat right Angles, and by the contraction of the Midriff, pulling it downward from a Concave Surface to a Circular Plain; whereupon the dimensions of the Breast being rendred much greater in length by the depression of the Diaphragm, as well as in breadth by the pulling the Ribs outward, a *Vacuum* must immediately follow, if the distended Lungs did not at the same moment

Some Learned Anatomists judge the inflation of the Lungs to be made by the sucking of Air.

The inflation of the Lungs with Air, is made to prevent a *Vacuum* in the Breast.

moment gradually fill up the cavity of the *Thorax*, as it is more and more amplified by the greater and greater depression of the Midriff; so that the inflation of the Lungs supplying the else empty place of the *Thorax*, is probably produced by the attracted Air, moving into numerous Cylinders of the Lungs, as when the upper and lower region of the Bellows are parted from each other, the inward cavity groweth greater, and the Air hath an immediate impetuous recourse through the Nofel into the more inward recesses of the Bellows. But the learned Anatomists of the opposite opinion, may reply, This repletion of the Bellows with Air may be accomplished not by Attraction, but Impulse, caused by the pressure of the superincumbent Air, forcing its ambient Particles into the Nofel and cavity of the Bellows.

An Experiment of Respiration fetched from Divers.

Somewhat may be farther offered in favour of Inspiration, produced by the attraction of Air into concave Vessels of the Lungs, which may be fetched from Divers, that can live some time under Water, which is contrived by an hollow Engine (fixed about the Breast, so closely, that it is not receptive of Water) in which the Diver breaths, while he remaineth under the water; so that he can receive no other Air (but what is contained within the close Engine) which cannot admit any ambient Air forced into his Mouth by the weight of any superior incumbent Particles; This may be said in answer to this Experiment, That this way of breathing is unnatural, by which the Diver can be supported but a very short time, and must be speedily drawn out of the water, to be revived by fresh Air, else he will be suffocated.

The inflation of the Lungs in Inspiration, is not made by suction of Air, but by the weight of the superincumbent Atmosphere.

In conclusion, I most humbly conceive, That the inflation of the Lungs in Inspiration is not celebrated by the attraction or suction of Air, but by the pressure of the Atmosphere, and elastick particles of Air impelling it into the greater and less Tubes, and Orbicular *Sinus*, blowing up the Lungs and filling up the Cavity of the Breast in time of Inspiration.

This Hypothesis is very highly made good by Learned Mr. *Boyles* most excellent Experiments in his well contrived Machine, wherein the minute Animals died, when the greatest part of Air was drawn out by art. Whereupon it may be reasonably deduced, that Air endued with such degrees of thinness, and grossness, beyond which on each side it is rendred unfit for Respiration. As to the thinness of it an evident Experiment is given by the said Experiment of the most Ingenious Author, in which the most part of the Air being exhausted out of an Air-pump, so that almost nothing but *Æther* remained, as divested of the Particles of Air for the most part, so that its reliques lost their Elastick power, and are made incapable of Motion into the greater and lesser Cylinders of Air in order to Respiration.

C H A P. LII.

Of the use of Respiration.

TH E Lungs being in it self a Compag (consisting of variety of Organs) is attended also with many neighbouring parts, assistant to its several motions, as being a noble, as well as useful Machine of Air, ministerial to Respiration, the great preservative of Life.

This excellent operation of Breathing is consigned by Nature to variety of uses, as it is made up of divers alternately repeated acts of Inspiration and Expiration; consisting in the various motion of Air, playing to and fro in the Diastole, and Systole of the Lungs.

The inspired Air is profitable to Smelling, Tasting and to the local motion, Fermentation, and mixture of the Blood with the Chyme; as also to the motion of the Chyle and Lympha.

The Expired Air is conducive to Speech, Voice, Coughing, Sneezing, and Spitting; and the Air being detained in the Lungs, doth promote the excretion of Urine and grosser Excrements, and also facilitates the Birth of Children.

The Antients have conceived the use of Respiration was only to cool the Blood, but if we well consider how Nature is supported in its vital flame of Life, we shall find the Blood, (by which it is maintained) to have a greater need of Heat than Coolness, to make good its local Motion, and Fermentation.

The use of Respiration is to cool the Blood.

Hippocrates, the Great Master of our Art, did attribute a necessity to Respiration, in reference to conserve Life; saying, that we can live some time without the entertainment of Aliment, but we cannot continue our Life many moments, without constant Draughts of Air, immitted freely into its greater and less Tubes, to spin out the thread of Life, by frequent repeated acts of Respiration, whose necessity chiefly appears in preserving the circulation of the vital Liquor.

It is a received Opinion, that Respiration is ordained by Nature, for the transmission of Blood, through the Lungs, from the Right to the Left Chamber of the Heart; And I most humbly conceive, that the Grand Architect hath made such a multitude of Divarications of Arteries and Veins (propagated through the whole Compag of the Lungs) to convey the stream of Blood, as through different Channels, from one ventricle of the Heart to the other, to promote the circuite of Blood through the Lungs, which is very much assisted by the contraction of them in expiration, compressing the Arteries and Veins; whereupon it is squeezed out of the Terminations of one, into the Origens of the other.

Another use of Respiration is, to transmit Blood through the Lungs.

Hence a reasonable account may be given of strangled Persons, either Hanged, Drowned, or Suffocated by a large quantity of serous Liquor (falling from the numerous conglobated salival Glands, of the Tongue, Palate, and adjacent parts into the Wind-pipe, and its smaller Cylinders) intercepting the current of Air, and mass of Blood through the Lungs, which compress the Blood-vessels by their weight, as narrowing, and closing their Cavities, so that they are not receptive of vital Liquor, which maketh a

stagnancy of Blood in the substance of the Lungs, and Right Ventricle of the Heart, as Learned Dr. *Harvey* discovered in a hanged Felon; as he writeth in his Epistle to *Riolan*, *Se in cadavere humano noviter strangulato, auriculam Cordis dextram & pulmones sanguine plurimum distentos atque infarctos reperisse testatur.*

Dr. Croon's
Experiment
to prove the
Air to assist
the motion of
Blood.

That this Hypothesis may be clearly understood, how much the inspired Air concurrerth to the motion of the Blood, I will propound some experiments. The First shall be that of most ingenious Dr. *Croon*, my worthy Colleague, when Professor of *Gresham* Colledge (before the Learned Fellows of it) who so strangled a Pullet, that the least spark of Life did not seem to remain; and afterward some Air being immitted by Art in the Mouth and Wind-pipe, the Pullet revived, by virtue of inspired Air, giving a new motion to the stagnated Blood in the Lungs.

Another Ex-
periment at
the Colledge
of Physicians.

Another Experiment I will make bold to propound, of a Dog opened alive in the Theater of the Colledge of Physicians, *London*, That when the Intercoastal Muscles and Diaphragme were wounded, and the currents of Air stopped, in relation to its motion into the Lungs; the pulsations of the Heart grew very faint, and almost wholly ceased; whereupon the Nofel of a Bellows being put into the Mouth of the dying Dog, he presently revived, at the immission of Air into the Lungs; and the Heart was restored to more vigorous pulsations, which continued some time, as long as Air was injected by Art, into the greater and less branches of the Wind-pipe.

A Third Ex-
periment of
Dr. Gualter
Needham, at
Gresham
Colledge.

Another Experiment was shewed by my worthy Friend Dr. *Gualter Needham*, a Learned Fellow of the Colledge of Physicians, *London*, at *Gresham* Colledge, before the Honourable and Learned Mr. *Boyle*, and many other Fellows of the said Society; The Experiment was acted upon a Dog hanged, which being opened, his Heart seemed to be free from all Motion; whereupon, most ingenious Dr. *Needham*, immediatly put a Pipe into the Thoracick Duct, and injected Air immediatly into it; whereupon the Heart and Blood recovered their motion, so that the Air mixed with the Blood, did speedily render it fluid, and did sollicite the vital Liquor, stagnant in the Right Ventricle of the Heart and Lungs, to a new motion and progress.

Bleeding re-
lieveth Respi-
ration in a
Squinancy.

And in great difficulty of breathing, even almost to suffocation, in Squinancies and inflammations of the Lungs, a free mission of Blood being celebrated by opening a Vein with a free hand, the vital Liquor settling in the substance of the Lungs, doth acquire a renewed circulation, by freeing them, partly from their load, and by having the Tubes of Air more open, as released from their compression, lately produced by stagnancy of Blood, in the substance of the Lungs.

Persons hang-
ed, have been
restored to
Life by Bleed-
ing.

Upon this account Men executed, having been immediatly let blood freely, have been restored to Life, by making good the circulation of the vital Liquor stopped in the Lungs; whereupon they play again anew, and receive fresh draughts of Air to impregnate the Blood with its spirituous, nitrous, and elastick Particles, to give a new circuit to it, through the Lungs and Heart, to preserve the soft flame of Life.

A Second Use
of Respiration.

Another Use assigned to Respiration, is the comminution of the Blood, (as being made up of heterogeneous Particles) by reason the Chyle is transmitted through the Thoracick Ducts into the Subclavian Veins, where it first confederates with the Blood, with which it is afterward carried through the descendent Trunk of the *Cava*, into the Right Ventricle, where the Chyle mixeth with the Blood, and is afterward communicated by the pulmonay Artery to the substance of the Lungs, and then to the Veins, wherein the

the Chyle espouseth a more intimate union with the Blood, as having an exacter Commination, accomplished by various Compressions of the Blood-Vessels, made by the distended Pipes and *Sinus* in Inspiration, and by the weight of the Lungs, leaning upon the Arteries and Veins in Expiration; so that the Blood of the Lungs appeareth more Red, as the Chyme is more perfectly assimilated into vital Liquor in the Lungs, then in the Right Ventricle of the Heart, which being opened in a Dog some hours after he hath been dead, the Blood is seen to run confused with the Chyme; whereupon it is often cloathed with a Whitish array; and when the Chyle is carried with the Blood into the Lungs, it receiveth a more perfect mixture, and the clammy parts are more attenuated, and fitted for motion, as they are exalted with the elastick and nitrous parts of Air, which do much contribute to conserve the heat of the Blood, as they do open and dilate it.

A Third Use of Respiration may be conceived to give a principle of Fermentation to the Blood, by reason it is a Liquor consisting of many different Elements of Saline, Sulphureous, and Spiritous Particles, which being acted with nitrous Particles of Air, impelled into the substance of the Lungs, and mixed with Blood, do render it more Fermentative, upon a double account; First, the *Æthereal* Particles impregnated with subtle Influxes (emanating from the Sun and other Planets) do insinuate into the body of the vital Liquor, and do very much exalte the more fixed and gross parts of the Blood, which is also enobled by Air, consisting of many volatil Steams, some Oily and Balsamick, others Saline, and Watry, breathing out of the Pores relating to the Bodies of Animals, Vegetables, and Minerals.

A Third Use
of Respiration.

The Effluvia flowing from different Bodies, have various tempers, as composed of several Elements, whose Particles are endued with different sizes and shapes, which being embodied with Air, and received into the Blood by Inspiration, do raise its intestine Motion, which is also much intended by the Nitrous Elastick parts of this noble fluid Body, which by reason of its more subtle parts, doth easily insinuate it self into the loose Compage of the Blood, and exalt its more sluggish fixed parts in a due Fermentation, while it passeth through the spongy substance of the Lungs.

The Intestine
Motion of the
Blood, is raised
by the
Elastick Particles
of Air.

Farthermore it is agreeable to Reason, the kindly and soft Effervescence of the Blood, ariseth from its fermentative Principles, as consisting of different crude Liquors, of Lympha, and Chyle (and other various Elements) Whereupon the vital Liquor is not a Jejune and poor, but a rich, opulent Liquor, endued with Particles of different Figures and Magnitudes, which are apt to Ferment, by reason the Blood is perpetually repaired by an alimentary Liquor (streaming out of the Thoracick Ducts) which being crude, passeth through the Subclavian Vessels, the *Cava*, and Right Ventricle of the Heart, and pulmonary Artery, into the substance of the Lungs, where it encounters Air; whereupon the Chyme mixed with Blood, is broken into small Particles, and assimilated into it, whereby the Blood groweth Florid and Frothy, as espousing Air, exalting its Crude, Saline, and Sulphureous Particles, with Nitrous Elastick Atomes.

The Antients have fancied hot Fumes to be secerned from the Blood, (flaming in the Heart) in Expiration, through the *Aspera Arteria* into the Mouth, but this being a temperate heat, seated in the Blood, cannot emit such fierce fuliginous vapours, as hath been formerly conceived; by reason the mild heat of the Blood cannot so colligate, burn, and scald it, as to send out such fiery Exhalations.

Wherefore

Wherefore I conceive it more probable to affirm, that watry Steams or Vapors are mixed with the effete Particles of Air, which do not stream from the Heart, but distill from the Glands of the Wind-pipe, into whose Cavity they are transmitted by secret passages; and sometimes these Vapors are impregnated with Saline Particles, which irritate the inward tender Coat of the Lungs; whereupon the Right and Circular Fibres of the Wind-pipe, are contracted to discharge by Coughing, these troublesome guests, the salt Vapours of the Blood, with the impetuous Motion of expired Air.

CHAP. LIII.

Of a Cough and Consumption.

The cause of
a Cough.

THE Nervous Liquor having lost its kindly mild temper, and being associated with ill qualified Lympha, doth confederate with the Blood in the Lungs, and produce a severe Cough, made by the irritated Fibres of the Bronchia, which are sometimes acted with violent Convulsive Motions, proceeding from the acide indisposition of the Blood, as mixed with depraved nervous Liquor.

The ill affecti-
on of the
Lungs, pro-
duced by the
obstruction of
the Lymphæ-
ducts.

Sometimes the Lungs may be disordered by the obstruction of the Lymphæducts, caused either by some viscous Humour, intercepting the course of the Lympha; whereupon the tender frame of these fine Vessels may be broken, and discharge their Liquor into the substance of the Lungs, and from thence into the Bronchia, and their Cells, whence they being provoked by a quantity of Liquor, will endeavour to expel it by Expectoration; and if the Lympha be disaffected with Acide Particles, derived from the Acrimony of the Blood, it may corrode the membranous Compag of the Lungs, so that the Bronchial and Pulmonary Arterial Branches may discharge some part of the Blood into the Receptacles of Air, wherein it being stagnant and putrefied, will generate a tabid disposition in the Lungs.

The sup-
pression of ac-
customed eva-
cuations of
Blood are
sometimes
the cause of
a Cough.

The suppression of accustomed evacuations of Blood, either by the Hemorrhoides, *Menstrua*, or Nostrils, do prove often very disadvantageous, by reason the ill parts of Blood, which were wont to be discharged by the said Vessels of different parts, have recourse to the Lungs, and irritate a Cough, ambulatory to a Consumption.

A suddain oc-
clusion of the
pores of the
Skin may
produce a
Cough.

The suddain occlusion of the pores of the Skin, (caused by the coldness of the ambient Air, or by a shower of Rain, or by the leaving off a Garment,) doth detain the Effluvia of the Blood, and disorder its temper, and cause an Effervescence, especially if the vital Liquor be vitiated with sharp Saline Particles, and surcharged with a quantity of ill Recrements, which having a recourse to the Lungs, do offend their fine Compag, and often provoke a Cough, ushering in a Consumption.

Thus having given some account of a Consumption in point of its Causes, an ill mass of Blood, as associated with a depraved nervous Liquor and Lympha; I will now make bold to speak somewhat in relation to the subject of this Disease, the Lungs, as they are disposed to the reception of this tabide Malady.

A Tabide Disease may proceed, First, from the ill conformation of the Breast, Secondly, from the innate weakness of the Lungs, and from a Hereditary indisposition, propagated from Consumptive Parents; or Thirdly, from Antecedent Diseases of the inflammation of the Lungs or *Pleura*; or from frequent Coughing up Blood, or from an *Empyema*.

A Conception may proceed from an ill conformation of the Breast.

To which may be added a gross Air, as clogged with noisom Smells, and Fogs, or envenomed with mineral Exhalations, coming out of the Earth, which do make ill impressions on the Blood (and nervous Liquor) rendring it gross, and apt to stagnate and putrify, inductive of a Tabide Disease, destroying the curious soft frame of the Lungs.

The Conformation of the Breast is very advantageous to the reception of Air into the inward recesses of the Lungs in Inspiration, and to the exclusion of Efflate Air, mingled with the hot steams of the Blood in Expiration; the First is highly promoted by the strong Fibres of the intercostal Muscles, and the motion of a well framed Diaphragme; and on the other side, if these machines of motion be ill framed, or affected with some Disease, the Thorax cannot be dilated in order, to give a free reception to the expanded Lungs in Inspiration; hence in deformed persons that have gibbous Backs, and narrow Breasts, the cavity of the Lungs is so contracted, that it intercepts the free play of the Lungs (making a difficulty of Breathing) and rendreth them obnoxious to a *Pthipsis*, proceeding from a gross dispirited, and stagnant, putrifying mass of Blood, caused by the defect of the nitrous, elastick Particles of Air, not freely received into the Vessels of the Lungs, in order to the refinement and exaltation of the Blood.

The innate weakness of the Lungs, doth very much contribute to their Tabide Affection, which consists in a laxe Compage of the Bronchia and *Sinus*, easily permitting the sharp Recrements of the Blood to pass into their Cavities; and by reason the carnos Fibres of the Wind-pipe, and its Branches are not strong, they cannot briskly contract to expel the Blood, and its superfluities extravasated in the Cavities of the Bronchia, and their appendant *Sinus*; whereupon the stagnant Blood putrifies and corrupts the fine vessels of the Lungs.

The innate weakness of the Lungs, disposeth to a Consumption.

Having entertained you with the procatare tick and conjunct Causes of a Consumption, I will take the liberty now to give you a taste of fresh Air, in which the Lungs highly please themselves to take their fill, as most grateful to Nature, to preserve the soft flame of Life, consisting in the motion of the Blood, which Air promotes by her nitrous elastick Particles; whereupon when it is moist and gross, as in Fenny Grounds, it loseth much of its purity and bounty, and discomposeth persons troubled with Coughing; and then a serene Air fanned with gentle wind, and influenced with a mild heat, proves amicable to the Lungs, afflicted with some kind of Coughs, proceeding from thick Blood, abounding with gross sulphureous Particles, so that thin Air of the Mountains, free from all smoak and gross vapours, is very acceptable to persons affected with Coughs, that have firm Pipes and *Sinus* of the Lungs, to which the more nitrous, sharp, elastick Particles of Air are acceptable, as being conducive to attenuate, and incide the gross chymous Particles of the Blood, lodged in the Bronchia, and their appendant Cells.

Good Air very advantageous to the Lungs.

But on the other side, in Persons endued with tender laxe Vessels, which are highly opened by thin sharp Recrements (distilling out of the extremities of the Bronchial and Pulmonary Arteries, into the Cavities of the Bronchia) a thin piercing Air, big with pure nitrous Particles, highly increaseth the Cough; and by attenuating the over thin and sharp Recrements of the

An over thin Air aggravates the defluxion of humors into the Lungs.

Blood, and by opening the porous and tender frame of the Receptacles of Air, doth cause a greater defluxion of acide humours, more enraging the Cough in this kind of Consumptive Persons, who are less afflicted in the gross smoke, and sulphureous Air of Cities (that burn Turf and Cole) which gratifies Coughs, (derived from thin acrimonious humors) often cured with Sulphureous, Balsamick Medicines, which are very proper in Ulcers of the Lungs; upon this account Sulphur may be called the Balsome of the Lungs, when they are oppressed with Coughs, flowing from saline Particles (brought to a *Fluor*) affecting the Blood, which being extravasated in the empty spaces of the Lungs, do highly irritate their membranous frame (endued with acute sense) by violent Coughing, which the thick sulphureous parts of Air (as giving some allay to the nitrous Particles) do much appease, and in some degree, take off the Acidities of the Blood, Lympha, and nervous Liquor, and make way for the cure of Consumptive Coughs, produced by sharp acrimonious Humors.

The Prognosticks of a Cough.

As to the Prognosticks of a Cough, they are not dangerous in strong healthy Bodies, who have a firm Compage of Lungs, not affected with gross, or sharp saline Recrements, and free from an acute Fever.

Divers kinds of humors expectorated by Coughing.

But in sickly Persons, inclining to a Consumption, that are tortured with violent Coughing, proceeding from thick clammy Humors, sometimes Yellow, and other times Greenish, there is imminent danger, especially if the great Cough be accompanied with high dejection of Spirit, and decay of the fleshy parts, difficulty of Breathing, and a constant slow Fever, derived from the Effervescence of the Blood; and when the Disease groweth more prevalent, wherein the Spitale becometh highly discoloured, as gross and putrid, flowing from an Ulcer of the Lungs, attended with a Heetick Fever, (coming from the Ulcerous Matter, infecting the Blood in its passage through the Lungs) and with frequent cold Sweats, arguing the great decay of the vital heat and strength, and then the Disease hath little of hope, as being accompanied with fatal symptomes.

The First Indication of a Cough.

In order to the cure of this Disease, Three Indications are offered: The First is, To take away the unkindly heat of the Blood, productive of Defluxion of serous Recrements, destilling into the Bronchia, and appendant Sinus of the Lungs.

The Second Indication.

The Second, is to discharge the Faces of the Blood ready for Secretion either by Expectoration, or by Sweat, or by Urine in the beginning of a Cough.

The Third Indication.

The Third is to corroborate the weak Compage of the Lungs by proper Pectorals, accompanied with gentle astringents, especially in the defluxion of thin Humors, into the Air-vessels of the Lungs.

In the First Indication, the Effervescence of the Blood is lessened by Bleeding in the beginning of a Cough, when the Patient hath strength; afterward gentle Diaphoreticks may be used, and temperating Juleps, made of Pectorals, as the Decoction prescribed in our *London Dispensatory*; as also cooling Emulsions made of the Seeds of Melons, Pompions, White Poppy, &c. which do allay the heat of the Blood; and by their mucilaginous temper, do hinder the defluxion of thin and hot Humors, into the membranous Compage of the Lungs.

CHAP. LIII.

The Pathology of the Lungs, and its Cures.

THE Lungs being an aggregate Body, made up of many parts, is subject also to variety of Diseases, viz. An Inflammation, Abscess, Ulcer, *Empyema*, *Asthma*, Cough, Spitting of Blood, and the Dropsy of the Breast, &c.

A *Peripneumonia* is an Inflammation of the Lungs, attended with an acute Fever, a Cough, difficulty of Breathing, and Redness of the Cheeks; the Patient affected with this Disease, findeth a great *Phlogosis* in the Breast, accompanied sometimes with heavy, dull, and other times with a pricking pain, a great Thirst, Restlessness, and spitting of Blood; whence it may be inferred, that this disaffection taketh its rise from the immoderate effervescence of the Blood, stagnated in the small Blood-vessels, lodged in the Bronchia or membranous *Sinus*, or from Blood, extravasated in the Interstices of the Vessels; whereupon the Vessels of Blood are swelled, in an obstruction of the small branches of the Bronchial Artery; and when the small Pipes of the Bronchia are compressed by the extravasated Blood settled in the empty spaces of the Vessels, causing an Inflammation, swelling of the Lungs, and difficulty of Breathing.

An Inflammation of the Lungs.

This Disease, (as I humbly conceive) proceedeth from a *Phlogosis* of the Blood, (making an Ebullition in the Lungs) and from its grossness, as often mixed with a crude Chyme, stopping the numerous small Bronchial Vessels of Blood. This assertion may be made good, that the obstruction of the minute Sanguiducts, is derived from a viscid gross Blood, by reason the Blood let out of the Vein, when cool, is covered with a White clammy skin, which is nothing else, as I conceive, but concremented crude Chyme, not capable to be broken into small Particles, and perfectly assimilated into Blood; so that the Blood being associated with the indigested clammy Liquor, and other gross recrements, doth sometimes obstruct the small branches of the bronchial Artery, and other times is extravasated in the Interstices of the Vessels; whereupon it acquireth an Ebullition, as having lost its due circulation in the Lungs.

The cause of an Inflammation of the Lungs.

And furthermore, the sulphureous Particles of the Blood, being embodied with the Saline and Earthy (when they are too much exalted by an unnatural Fermentation) the vital Liquor is highly incrassated, and growethropy (somewhat resembling over-fermented Wine acquiring a glutinous disposition) productive of an Inflammation of the Lungs.

It is oftentimes observed by Learned Authors, that the Inflammation of the Lungs is sometimes a fore-runner, and other times a Consequent, and oftentimes a Concomitant of the Pleurisie; upon which, great inquiries have been made, by what ways the Morbifick Matter can be translated from the Lungs to the *Pleura*, or from the last to the former; some conceive, that some part of the Blood being discharged the *Pleura* into the Cavity of the Breast, may be sucked up into the Lungs, after the manner of a Sponge, which seemeth to oppose the Oeconomy of Nature, who hath clothed the Lungs

Lungs with a firm, though thin covering, not capable to admit the gross clammy Blood, coming from the *Pleura*, and thrown into the capacity of the Thorax.

The inflammation of the Lungs is sometimes solitary, and other times accompanied with a Pleurisy.

Whereupon I humbly conceive, that the diseases of the Pleurisy, and the Inflammation of the Lungs, are sometimes Concomitant, and sometimes Successive, and are produced by gross viscid Blood, carried into the *Pleura* and Lungs (by different proper Blood-Vessels) either at the same, or at several seasons, which rendreth the Inflammation of the said parts, to be sometimes companions, and other times separate, when the stagnated Blood hath an Ebullition in the *Pleura* and Lungs, at one, or several instants of time.

An Apoplexy and Hemiplegia succeeds the inflammation of the Lungs.

Sometimes an Apoplexy, or *Hemiplegia* succeed, or are companions of a *Peripneumonia*; in the First Diseases the gross Blood is transmitted in an exuberant proportion, by the internal carotide Arteries into the Coats, or substance of the Brain, compressing the Origins of the Nerves; and in an Inflammation of the Lungs, the Blood is imported by peculiar Arteries into the substance of their Bronchia and membranous *Sinus*, in which it stagnates, and generates a Feverish effervescence of the Blood.

As to the Prognosticks of this Disease, it is very dangerous, in reference to a difficult Respiration, sometimes speedily cutting the fine Thread of Life; and to an acute Fever, derived from stagnation of Blood, in the most minute bronchial Arteries; as also in the Interstices of the Vessels, which is hardly cured; especially when it is attended with cold clammy Sweats, Convulsive motions, fainting Fits, and a quick weak Pulse, the fore-runners of death.

The Prognosticks of a *Peripneumonia*

This disease is also full of danger, when nothing is expectorated, or a thin indigested Matter, and it is more hopeful, when a thick Yellow well concocted Phlegme is easily expectorated, interspersed with a little Blood.

The Indication of a *Peripneumonia*

The Indications offering themselves in this disease, are divers, the First is, that the Blood stagnated in the substance of the Bronchia and membranous Cells be discharged by Motion; and that the concremented Blood having so great a recourse to the Lungs, be diverted, and lessened by the free opening a Vein, that thereby the Blood extravasated in the Interstices of the Vessels, may be received into the Origins of the Veins, to make good the circulation of the Blood.

Blood-letting is very proper in a *Peripneumonia*.

And in this disease, repeated Blood letting is very beneficial, if the Pulse be strong, to take off the great quantity of vitiated Blood, and to procure the stagnate Blood to be conveyed into the extremities of the Veins.

Pectoral Apozemes are very good.

And also pectoral Apozemes made of the roots of Dogs Grass, wild Asparagus, the Leaves of Maidenhair, Coltsfoot, Liquorice, which do attenuate and incise the gross clammy Blood, and other gross Excrements, which stop the Bronchia and vesicular *Sinus*, and Linctus made of new Linseed-Oil, and Sugar, and oxymel of Squills, mixed with simple oxymel, Syrup of Maiden, Liquorice; and strong Purgatives are not proper in this disease, lest they should enrage the boiling Blood, and carry it more freely into the offended noble parts.

Strong Purgatives are dangerous in a *Peripneumonia*.

Opiates are disadvantageous in this case.

In this case Opiates may not be advised in great watchfulness, by reason they incrassate the Blood, and increase the difficulty of breathing in hindring Expectoration, and render the stagnated Blood more impacted in the small Air-pipes, and their appendant *Sinus* in the Lungs.

Testaceous

Testaceous Powders of Crabs Eies, Pearl, Sugar of Pearl, Salt of Prunel, and mild Diureticks are very beneficial in this Disease.

Diaphoreticks and Diureticks are safe.

And some drops of tincture of Saffron, or Spirit of Saffron, Spirit of Tartar, Spirit of Niter often rectified with Spirit of Wine, may be given in a draught of the Pectoral Decoction, (often in a day) to which may be added in the preparing of it, some Flowers of Red or Field Poppy.

If the pain of the Breast be urgent, and in reference to help Expectoration, Ointments made with Oil of Mace, Ointment of Marshmallows, Oil of Linseed mixed with Orange-flower Butter, may be applied to the Breast with Lawn Paper.

Topicks may be applied to the Breast in this disease.

Some Cases may be given of this Disease, As First, a Person of Quality, a Knight of the Bath, was highly afflicted with a violent pain in his Foot, whereupon a Pultice was imprudently applyed, without the advice of a Physician; which repelled the Goutish humor, was afterward transmitted into the small Arterial Branches of the Bronchia, and their appendant Cells, wherein the gross clammy Blood settling in the Vessels, or their empty spaces, caused an Inflammation of the Lungs, accompanied with a great Fever and Thirst, and pricking pain, and much spitting of Blood, and a most difficult Breathing, even almost to Suffocation.

An instance of a Peripneumonia.

In order to the Cure, I advised, Blood-letting, with a large Orifice of the pierced Vein, and a free Hand; whereupon he found some alleviation; I also advised proper pectoral Apozemes, made up of inciding and attenuating Ingredients, and various Lambitives; in great difficulty of breathing I gave him *Elixir Proprietatis*; and Spirit of Harts-horn, and Spirit of Saffron are good, either given of themselves, or best in a draught of Pectoral Decoction; whereupon he expectorated a great quantity of gross clammy Matter, mixed with Blood. I also prescribed often Blood-letting to the Patient (as having a very strong Pulse, and a very large mass of Blood) which succeeded very well, it being accompanied with variety of Pectoral Medicines; whereupon the Patient was perfectly recovered to his former health, to the Glory of God, and the great joy of his Physician and Friends.

A worthy Knights Lady was highly afflicted with a Fever, great difficulty of Breathing, and a large quantity of Blood, expectorated with thin spittle, plainly shewing this distemper to be an Inflammation of the Lungs; and to appease it, I often advised a Vein to be freely opened in the beginning of the Disease, but she was inexorable after great sollicitations, and being struck with a great dread, upon the motion of Bleeding, would not submit to the Lancet, so that the generous remedy of Bleeding, being not administered, she paid dear for its neglect, even to the loss of her Life, which could not be purchased by the application of many excellent pectoral Medicines.

Another instance of an Inflammation of the Lungs.

C H A P. L V.

Of the Abscess of the Lungs.

The cause of
an Abscess of
the Lungs.

IN an Inflammation of the Lungs, the substance of the Bronchia and *Sinus* are distended with a quantity of gross Blood, either settled in the small Ramulets of the bronchial and pulmonary Arteries, or extravasated in the Interstices of the Vessels; so that the Blood cannot be received into the Origins of the Veins, and carried into the Left Ventricle of the Heart, which chiefly happens when Blood-letting is omitted, which if celebrated, would have lessened the quantity of Blood, and diverted its current from the Lungs, and solicited the stagnated Blood in order to motion, into the extremities of the capillary pulmonary Veins; which Nature being not able to make good, the stagnated Blood loseth its tone, and groweth corrupted, and its Albuminous part is separated from the Purple Liquor, and turned into a *Pus*; whence ensueth an Aposteme, which is a collection of purulent Matter in the substance of the Bronchia, and membranous Cells, annexed to them, which became putride by the sharp indisposition of the *Pus*, received into their Cavities, which being very sensible of their burden, as composed of nervous and carnos Fibres, contracting themselves to expel the corrupt matter of the Abscess through the greater and less Air-pipes of the Lungs into the Mouth.

An Apo-
steme, called
*Vomica Pulmo-
num*.

An Aposteme of them, called *Vomica Pulmonum*, is much akin to that produced in a *Peripneumonia*, only it is mere *Pus*, generated without a Fever, Inflammation, Cough, and Spitting, secretly, and of a suddain, and worketh so inwardly without the notice of any symptome, that it cutteth off the Patient in a moment by suffocation, before the Disease can be discovered.

Learned *Tulpius* giveth an account of this disaffection, *lib. 2. cap. 10. Vitium hoc (Pulmonis Vomica innuens) latet inter initia ita clanculum, ut vix ulla sui proferat indicia, præter Tussiculam primo siccam, mox humidam; qua aliquandiu continuante, trahitur difficulter spiritus, deficit anima, & emarcescit paulatim corpus, licet interim nec Pus, nec Sanguinem præ se ferunt sputa; sed si rumpatur inopinato vomica, occiditur (dictum ac factum) homo.*

A *Vomica Pul-
monum*, not
always dead-
ly.

But I humbly conceive that this kind of Abscess is not always mortal, and no way proceedeth from a *Peripneumonia*, or *Pthisis*, but a weak disposition of the Lungs, inclining them to putrefaction, and doth not always come of a suddain, but insensibly, and by degrees, whereby the *Pus* having its first Origen from some depraved humor, groweth more and more matured, and by its caustick quality, corrodeeth the Bronchia and *Sinus* appendant to them, and streameth in the Cavities of the Wind-pipe, and is at last ejected the confines of the Body.

This Disease, if its nature be inspected according to its continent cause, may be styled a true Abscess, produced in the Lungs from some impure Recrements, or Heterogeneous parts of the Blood (apt to be turned into *Pus*) which being secerned from the more refined, are lodged in some, or many Cells, appendant to the Bronchia, and are there confined within some proper Membrane: These impure parts of the Blood, are not endued with any great Acrimony, productive of a Cough; neither have any great Effervescence

Effervescence proper to a Fever, which is very small, if any; in a *Vomica Pulmonum*, these vitious humors, by degrees, come to maturation, and become purulent, and break the confines of the Membrane, or *Cystis*, which is received into the Bronchial or pulmonary Veins, and infects the Blood; and hinders its circulation; or else the *Pus* when the *Cystis* is broken, is discharged in a great stream, into the greater and lesser Cylinders of Air, and by intercepting its current into the Lungs, doth speedily extinguish the flame of Life; but if the Matter of this Abscess doth distil softly into the *Sinus* and *Bronchia* of the Lungs, it may be expelled by expectoration, and then some hopes of recovery do present themselves, and give an opportunity of Medicines.

In this Disease, which doth not betray it self by any symptomes, it is very difficult to make any Prognosticks, because the matter of the disease lieth lurking in the Body, and when the purulent Matter is digested into a *Pus*, the *Cystis* is violently broken, and the Air-vessels are immediately stuffed, so that free draughts of Air cannot be received into the Lungs to support the vital flame.

But if the *Pus*, flowing out of the broken *Cystis*, doth gently drop into the less and greater Tubes of Air, the purulent Matter may be thrown up, to give an advantage of a Cure by proper Medicines: And to this end, pectoral Apozemes may be given, made of the opening Roots, Ground-Ivy, Hyssop, Liquorice, sweetned with Honey of Roses, or Syrup of the opening Roots.

Lambitives are also very proper, composed of several sorts of Oxymels, Syrup of Ground-Ivy, Hyssop, Horehound, of the opening Roots; as also a Linctus, prepared with Linseed-oil, and that of Sweet-Almonds, beaten up with Syrup of Maiden-hair, &c.

Sometimes an Abscess of the Lungs is produced by the lacerated capillary Vessels in the skirts of the Lobes upon a wound; whereupon so great a quantity of Blood being lodged in the Interstices of the Vessels, (that it cannot be received into the Origins of the pulmonary Veins) must necessarily lose its tone and goodness for want of motion, and be turned into a *Pus*, which being conveyed through the corroded Membranes into the Cavity of the Bronchia, may be thrown up through the Trunk of the *Aspera Arteria*, into the Mouth, and cured by proper vulnerary Diet-drinks, consisting of cleansing, drying, and consolidating Medicines.

An Abscess of the Lungs proceeding from a wound.

An instance of this case may be given in my worthy Friend and Patient, Mr. *Beversham*, a Major in the late Kings Service (of Sacred Memory) where he unhappily received a shot with a Pistol through the upper part of the Thorax, and the Left Lobe of his Lungs, whereby, after divers days, he was surprized with a Fever, and a great difficulty of Breathing, which ceased upon the coughing up a great quantity of purulent Matter, flowing from a broken Abscess of the Lungs, which afterward was perfectly cured, by a proper method of Physick; about Four or Five and twenty years ago, and the gallant Major, is yet alive and well, to the Glory of God, and the comfort of his Friends: He being a person of great Loyalty and Friendship.

An instance of an Abscess of the Lungs caused by the shot of a Pistol.

C H A P. LVI.

Of the Pthifis, or Consumption.

A Consum-
ption, or
Atrophy,

TH E Consumption, or Atrophy of the whole Body, doth not arise solely out of the Lungs, as affected with an Ulcer, or any other disease, but also from a depraved mass of Blood, not fit for nutrition; which I confess, proceedeth very often from disaffected Lungs, wherein the vital Liquor receiveth a great imperfection, as embodied with Air, wanting spirituous, nitrous, and elastick Particles, not opening the body of Blood, by breaking it into small Particles, which would much contribute to the mixture of it with Chyme, the *Materia substrata* of Blood; so that if the Air be ill, and the Lungs diseased, the Blood groweth crude and vitiated, and loseth much of its nutritive disposition.

The definiti-
on of a Con-
sumption, or
Atrophy.

A *Pthifis* is commonly defined an *Atrophy* of the whole Body, derived from an Ulcer of the Lungs, and may proceed as well from other diseases of the Lungs, as being obstructed by any Swelling, or Stones, or fabulous Matter, as Learned Dr. *Willis* hath observed. *De Pthifi pulmonari Sect. 1. Cap. 6. P. 54. Pthifis definiri solet, quod sit totius corporis intabescencia, ab ulcere pulmonis orta; verum minus recte; quia plurimum ab hoc morbo defunctorum cadavera aperui, in quibus pulmones ulcere quovis immunes, tuberculis, aut lapidibus, aut materia sabulosa per totum Consiti fuerunt.* So that the Lungs being stopped, either in the cavities of the Pipes, or Cells, or by compression of the neighbouring parts, the Air cannot be freely received into the inward Recesses of the Lungs, to associate with Blood; whereupon it loseth much of its fineness, for want of motion, which is also hindred by the said obstruction of the Lungs, where the Blood is rendred gross and dispirited, and unfit for nutrition, productive of a Consumption.

The causes
of an Atrophy.

The Antients have assigned two causes of this disease, a Catarrh, and the breach of some Blood-vessel; to which may be added an Abscess, which above all, vitiaterh the mass of Blood, and highly contributeth to a *Pthifis*: and others affirm, (though improperly) pituitous Matter falling from the Head, through the *Glans pituitaria*, to be the cause of a Consumption, which cannot be proved by Reason, because the serous Recrements flowing from the Brain, into the *Glans pituitaria*, are received into the jugular Veins, and do not all distil through the Mouth, as was antiently imagined, into the *Aspera Arteria*, and Bronchia of the Lungs, thereby producing a Cough.

Dr. *Willis* his
Opinion, that
no Catarrh
can fall from
the Palate up-
on the Lungs.

Learned Dr. *Willis* conceiveth, that no Catarrh can fall from the Palate upon the Lungs, *At ille, nullus omnino humor aut acerebro aut e palato in pulmones depluat.* But with deference to this worthy Author; I humbly conceive, that the serous Particles of the Blood, mixed with nervous Recrements in the Glands of the Palate and Tongue, may be thence transmitted through excretory Ducts into the Mouth, and may distil down the sides of the *Aspera Arteria*, and cause a Cough, which may be proved by the great tickling these Humors make all along their passage, from the *Larynx* to the inward recesses of the Bronchia, whereby they are often corroded by the sharp *Fæces* of the Blood, and cause a Consumption of the Lungs.

In truth, the
serours parts
of the Blood
may be con-
veyed
from the Pa-
late into the
Wind-pipe
and Lungs.

And

And I do also verily believe, that some part of the Catarrh, dropping down the sides of the Wind-pipe, doth proceed from the Glands adjoyning to it, which convey some serous Liquor of the Blood through small Pores of the *Aspera Arteria*, to bedew its inward Coat to keep it moist, lest it should be too much decomposed by hot steams of the Blood, excerned in Expiration.

And other serous Recrements of the Blood, do distil through the terminations of the Bronchial and Pulmonary Arteries, though minute passages, into the Cavities of the Bronchia, and their annexed *Sinus*; whereupon a Cough may often arise, whereby Nature endeavoureth to discharge these noxious Humors, which if detained in the mass of Blood, do often vitiate its Constitution, and generate a Consumption, as making the Blood unfit to repair the decays, relating to the substance of the whole Body.

Serous Recrements may distil out the Arteries into the Bronchia.

And other more gross Recrements of the Blood, being Particles of indigested Chyme, do render the Blood so gross, that it is forced to part with them, in the substance of the Bronchia, and *Sinus*, before it can be entertained into the extremities of the pulmonary Veins; whereupon these gross *Fæces* do insinuate through the Pores, into the Cavities of the Air-pipes, and their Cells, and are afterwards turned out of doors by Coughing: These foul Recrements of crude Chyme, being embodied with the Blood, do render it so thick, that it cannot move; so that its more gross parts do stagnate, either in the minute Ramulets of the Arteries, belonging to the Air-pipes, and their membranous *Sinus*; or in the Interstices of their Vessels; whereupon the Blood is bereaved of its Motion and Tone too, and groweth corrupt, producing an Aposteme in the Lungs, which as I humbly conceive, is a great cause of an Ulcer and Consumption of the Lungs, and Atrophy of the whole Body, generated by putride Matter in the Lungs, depraving the mass of Blood in its circulation through the pulmonary Vessels; whereby it becometh disserviceable for nutrition.

The gross parts of the Blood may be transmitted into the Bronchia.

The Blood also suffers very highly, as contracting an ill quality, by its confederacy with ill Air (in the body of the Air-vessels) affected with gross or malignant vapors, exhaled out of stagnant waters, and out of Minerals, lodged in the bowels of the Earth, infecting the mass of vital Liquor, and generating a Pthysical indisposition, which happens to persons living in Marishes, and places, whose Air is made noxious by Mineral Arsenick, or Mercurial Steams, whereby the Blood loseth its motion and native Crasis; and corrupteth the fine airy Compage of the Lungs.

Ill Air may produce a Pthysis.

An exuberance also of serous and gross chymous Recrements, thrown into the Bronchia, and Cells, which cannot be discharged by expectoration, grow gross and stagnant in the said receptacle of Air, and by degrees tend to corruption, and stop up the Pipes, and intercept the free current of Air, and spoil the purity and attenuation of the Blood, and hinder its mixture with Chyme, whence it is made liable to stagnation, and corruption in the substance of the Lungs; whereupon the vital Liquor being rendred gross and viscid, cannot insinuate it self into the pores of the more or less solid parts of the Body, in order to assimilation.

Gross Chymous Recrements thrown into the Bronchia, may produce a Pthysis.

The great streams of Serous and Chymous Recrements of the Blood are often discharged by the terminations of the Arteries, into the bosome of the Cylinders and *Sinus* of Air, contained in the body of the Lungs, so that the tender Compage of the Receptacles are lacerated, by the superabundant quantity of Recrements, transmitted into them; whence a lake of ill humors is lodged in the many *Sinus* of the Lungs, broken into one, making a putride source, or pond of tabide corrupt Matter, putrifying the substance of the

Lungs; whence the serous and gross *Fæces* of the Blood, do flow in so great a quantity into the Cavities of the Bronchia, and their annexed Cells, that they cannot be ejected by Coughing, so that the great lake of stagnant Humors, doth make great Effervescences, and some part of these Recrements, being embodied with the Blood, is received into the pulmonary Veins, and imparted to the Heart, productive of a Fever (which frequently accompanieth a Consumption) and hath for its attendants an unkindly heat, a dejection of Appetite, Night-Sweats, and an Atrophy of the whole Body.

The membranes of the Bronchia may be turned Callous.

Sometimes Nature armeth it self against the return of these corrupt Humors, out of the *Sinus* and Pipes into the mass of Blood, by rendring the walls of their vessels hard and Callous, which is mentioned by most Ingenious Dr. Willis, Sect. 1. Cap. 6. *De Pthysi Pulmonari. P. 57. Interdum accidit ejusmodi lacum, sive foveam unicam, aut forsan in pulmonibus efformari, easq; circumcirca parietes Callosos obtinere, ita ut materies ibi collecta, in massam sanguineam minime transferatur, sed quotidie tota licet ingenti copia expectoretur.*

Persons affected with these consolidated Pipes and *Sinus*, or as it were a fountain of Fæulent Humors in the Lungs, throwing out a quantity of thick yellow Spittle, resembling purulent Matter, produced by its long stagnation in the vessels of the Lungs.

This gross Phlegme being every day expectorated in great proportion, doth ease the Air-vessels of their loads; whence a free Respiration is made, and the Appetite preserved, and natural Rest enjoyed; but others clogged in their Lungs with superabundant serous and chymous Recrements, do Spit less, and having these foul Humors (stagnated in the vessels of the Lungs) corrupt them, generating a tabide indisposition, the fore-runner of death,

The remote causes of a Consumption

Having Treated of the continent cause of a Consumption, I will take the freedom, with your leave, to discourse of the more remote, evident, and antecedent causes, which may be comprized for the most part within these two Heads, the perverted Crasis of the Blood, and the weakness and disaffection of the Lungs.

The Blood groweth gross, as not refined in the Glands of the Viscera.

As to the First, the choice Liquor of the Blood is depraved, when it is not depurated in the Glands of the *Viscera*, (which are instituted by nature, as so many Colatories of the vital Juyce) or when it is not secerned from its bilious *Fæces* in the miliary Glands of the Liver, or from its serous Recrements in the Glands of the Kidneys; or from its hot steams through the pores of the Skin, in a free Transpiration; or from its watry superfluities through the Glands, and excretory Ducts of the Skin; so that the many wonted percolations of the vital Liquor being deficient, its constitution is vitiated, and being transmitted (as overcharged with variety of noisome heterogeneous Particles) through the Right Ventricle of the Heart, and pulmonary and bronchial Artery, into the greater and lesser Tubes and *Sinus* of Air, doth there stagnate and acquire putrefaction, destructive of the membranous tender Compage of the Lungs, thereby inducing a tabide indisposition of them, infecting the mass of Blood, circulating through the Lungs, whereby it is rendered unprofitable for Assimilation, into the substance of the Body

CHAP.

C H A P. L V I I.

Of a Cough and Consumption, and their Cures.

IN thin distillations, *Linctus* made of Syrup of Jujubes, Coltsfoot, dried Roses, mixed with powder of Gum-Tragacanth, Arabick, are very profitable.

The Cure of thin Distillations.

In great Catarrhs, flowing from hot thin recrements of the Blood, incrasating Pectorals, mixed with Syrup of Red Poppy, *de Meconio*, and drops of liquid *Laudanum Cydoniatum* are proper, which do thicken the thin acide Humors, and hinder distillations; and in this case Balsome of *Peru*, and *Tolu*, are very beneficial: As also Tablets of Red Roses, prepared with *Diacodium*, and *Trochiscs*, prepared with Extracts of Liquorice, and Sulphur, which do restore the loose Compage of Blood to its due tone, and preserve it from superabundant serous Recrements, flowing in too great fusion.

As to the Second Indication, in reference to discharge the Recrements of the Blood, fitted for Secretion, gentle Purgatives of *Manna*, Syrup of Peach-Flowers, added to pectoral Decoctions, prepared with *Senna*, may be administered; and afterward Diureticks made with Roots of Dogs-grass, wild *Asparagus*, *Bruscus*, Leaves of Golden-rod, with the cooling Seeds, and *Millepedes*, boiled in water, to which, when strained, a little White-wine, and Syrup of the Five opening Roots may be added. In this case also testaceous Powders of Crabs-Eies, and Claws, of Pearl, Coral, &c. may be given, which take off the acidity of the Blood, and promote Sweats, which are proper in the beginning of a Cough, when Bleeding and Purging have been celebrated.

Gentle Purgatives, mixed with Pectorals, as proper in Coughs.

The Third Indication is satisfied in corroborating the Lungs, by shutting up the too much opened Pores of the Bronchia, and their *Sinus*, whereby their loose Compage is rendred more firm by pectoral Medicines, mixed with gentle astringents, made of the Roots of *Tormentil*, *Cumphrey*, *Dayfies*, mingled with the Leaves of Bugles, *Prunel*, &c. boiled in Barley water, and after straining, it may be sweetned with Syrup of dried Roses, Coral, &c. These and the like Medicines, strengthen the weak frame of the Lungs, and hinder the motion of hot thin recrements of Blood by Incrassation; which is also effected by *Linctus*, prepared with Syrup of Field-Poppy, dried Roses, *de Meconio*, mixed with the species of cold *Diatragacanth*, to which may be added some drops of *Laudanum liquidum*, an excellent Medicine in Distillations, falling into the Air-vessels, which are generated by thin, hot, or acide Recrements of the Blood.

Corroborated Medicines are good in Laxe Lungs.

Before I Treat of the Cure of a Consumption, I shall endeavour to speak more fully of a Cough, and particularly of the Chincough of Children.

The causes of a Cough.

Coughs (as I humbly conceive) proceed chiefly from gross Phlegme, which is crude Chyme, running confused with the Blood, and is transmitted through the more loose Compage of the Bronchia, and their annexed *Sinus* into their Cavities, by the terminations of the Bronchial and pulmonary Arteries, or else the Blood growing sower like Milk (as Dr. *Willis* phrazeth it) doth quit its native sweet Ingeny, and its serous parts are brought into a Fluor, by exalted saline Particles; whereupon the acide Recrements being thin and

and Fluide, do easily insinuate themselves through the pores of the Air-vessels into their Cavities, so that their membranous substance, composed of numerous nervous Fibrils, finely interwoven, is very sensible of the burden of Recrements, lodged in their bosom, and do contract their Right fleshy Fibres, drawing the annular Cartilages of the Bronchia closer to each other, and do move their circular carnosus Fibres inward, thereby narrowing the Cavities of the Cylinders of Air, with a strong impulse of Breath in Expiration, whereby the *Fæces* of the Blood oppressing the Bronchia, are violently ejected into the Mouth.

Of a Chin-cough with Convulsive motions-

Another kind of Cough, called vulgarly the Chin Cough, afflicteth Children with severe repeated Fits, in which they are acted with Convulsive motions, producing a great difficulty of Breathing, even almost to Suffocation, interrupting, suspending, or perverting the choice Oeconomy of Nature, in the acts of Respiration; and for the most part the Midriff is Convulsed, either of it self, or by the agitation of the adjacent parts, so that it seemeth to lose its motion in extraordinary pauses, either by intermitting sometimes its Systole, and other times its Diastole, for too great a space, beside the order of Nature; so that the acts of Respiration seem now and then to cease, and other times to be disorderly, as performed in a Convulsive manner.

The continent cause of a Chincough.

The continent cause of the Chincough is most sharp, and almost a continued irritation of the Bronchia of the Lungs, from thin sharp recrements of the Blood, producing many repeated Contractions of the fleshy Fibres, to discharge the load lodged within the many Concave surfaces of the Pipes.

The matter of the Chincough seemeth to be a quantity of thin sharp recrements of the Blood, perpetually distilling out of the terminations of the Arteries, into the Cavities of the Bronchia, and unceasingly provoking the nervous and fleshy Fibres of the Lungs, to expel the Acide *Fæces* of the Blood, having a great recourse to them.

The cause of Convulsive motions in a Chincough.

And I humbly conceive, the cause of the Convulsive motions of the nervous Fibrils in the Chincough, to be an ill nervous Liquor, full of Elastick parts, derived from the Brain, and communicated to the nervous Fibrils of the Bronchia. Therefore in this Disease, not only the recrements of the Blood, as in other Coughs, but the depraved nervous Liquor is to be amended also, which produceth Convulsive agitations of the machines of motion in the Breast. In this case Moss of the pale, and other Moss, in divers preparations is often given, sometimes it is powdered, and mixed with Sugar-Candy and taken in some proper pectoral Decoction, or simple Waters of Hysop, Coltsfoot; Powder of Moss is also mingled with Milk of Sulphur, and used in the said Vehicles; as also boiled in Milk. Moss in reference to its taste, seemeth to be endued with an astringent quality, whereby it shutteth up the too much dilated pores of the Bronchia, and annexed membranous Cells, and restraineth the Flux of thin and hot Recrements of the Blood, into the Cavities of the Air-pipes.

Diet-drinks are proper in this Disease.

Sometimes a gentle Vomitory of Oxymel of Squills, proveth very successful in the Chincough; as also Syrup of Peach-Flowers, mingled with Simple, or some Compound Briony-water is of great benefit.

Blood-letting is good in a Cough, relating to a plethorick Constitution of body.

Decoctions of Sarza-parilla and China may be taken, instead of Beer, for an ordinary Drink, as boiled in Water with Raisons of the Sun, and a little Liquorice, infused a moment or two.

Children, endued with plethorick Constitutions, as abounding with great store of Blood, will admit of Bleeding to two or three Ounces with a Lancet, or with Leeches.

Millepedes

Millepedes bruised alive, may be infused in some pectoral Decoction, or Simple Waters, to which may be added, when strained, some proper cephalick compound Waters, with some double refined Sugar, two or three drops of Tincture of Sulphur, or *Lac* of Sulphur may be used in some convenient Liquor.

I have given a History of divers kinds of Coughs and their Cures, as making way for a Consumption, as an inveterate Cough, which often degenerates into it, when it is so far aggravated, that the native Compage of the Blood is loosened, by reason, not only the serous Recrements, but the Chyme, nervous Liquor, and Lympha, are transmitted through the pores of the Membranous frame of the Bronchia, and their appendages into their Concave spaces; whereupon the vesicles of the Lungs grow so tumefied, that their fine party-Walls are broken, and one common vesicle is made of many running into one, wherein a quantity of divers sorts of Recrements are accumulated, whence ariseth a great Effervescence, derived from superfluous Fermentations, Liquors of a contrary Ingeny, as endued with heterogeneous Elements; whereupon they being stagnant in the spaces of the Vesicles, do often ferment and putrefy, and by corroding the tender membranous composition of the Lungs, do generate, First, a deep Cough, and then a Consumption, so that the mass of Blood transmitted through the Lungs, is tainted and made unfit for nutrition.

In reference to the cure of this Tabide distemper, Three Indications do occur; The First is to rectify the lax body of Blood, to keep it from throwing its chymous and serous *Faces* in the bosom of the Bronchia, and Vesicles; As also by correcting the Acidity of the vital Liquor by sweetening Medicines.

The First Indication in the cure of a Consumption.

The Second Indication to help the expectoration of gross and sharp Recrements by specifick Pectorals.

The Second Indication.

The Third Indication is to make good the dissolved union, or continuation of parts, by healing, strengthening, and drying Medicines.

The Third Indication.

The First Indication may be chiefly satisfied in Aliment of an easy Concoction, that the milky extract, elaborated first in the Stomach, and afterward conveyed by the Thoracick Ducts into the subclavian Vessels, may be assimilated into the Blood, without making great superfluities, which are causes of great Defluxions, Coughs and Consumptions; and that the Aliment may be composed of sweet and mild parts, which may be easily separated from the more gross, (as being for the most part) Homogeneous, may be turned into Blood, without any high or unkindly Effervescence; whereupon Asses, Cows, or Goats-milk, Water-gruel, Barley-gruel, Barley Cream, Panada, and Aliment, prepared with Almonds, as not consisting of many Heterogeneous Elements, are easy of digestion; but a Diet of several kinds of fat Flesh, is hard to be concocted, and nourisheth less in a weak Consumptive Body, by reason, when the alimentary Liquor is strong and gross, it cannot be turned into good Blood, and being Fermentative, as made up of many disagreeing Particles, doth make an ill Fermentation of the Blood; so that crude Chyme extracted out of Meat hard of digestion, doth not feed the Body but the Disease.

Flesh not good in weak Tabide Bodies.

Secondly, By reason the Tone of the Blood being loose, it is apt to be dissolved into many serous recrements; whereupon it is very agreeable to reason, that Medicines sweetening the Blood should be exhibited, as vulnerary Apozemes mixed with pectorals, which take off the acidity of the blood, when Medi-

cines prepared with Sulphur, are added to them, which are to be freely used, if a Hectick Fever be absent.

Restorative Medicines are beneficial in a *Pthysis*.

In the beginning of a Consumption, Bleeding, gentle Purgatives, and Diureticks, &c. are good.

Decoctions also made with roots of China, Sarza-parilla prepared with Ground-Ivy, Maidenhair, Raifons of the Sun, &c. may be freely taken for common Drinks in Tabide Bodies.

Thirdly, The First Indication in the beginning of a Consumption may be satisfied by lessening the exuberant superfluities of the Blood by Bleeding, gentle Purgatives and Diureticks, warm Baths, Fontanels, Blistering Plaisters, Shaving of the Head, Cephalick Plaisters, gentle Sternutatories, and Medicines evacuating serous Recrements out of the Oral Glands, by the Excretory Ducts of the Mouth and Tongue.

Attenuating Inciding, and detergent Medicines are advantageous in Coughs and Consumptions, arising out of a gross, viscid, len- tious Matter.

The Second Indication in the rise of a Consumption, is satisfied by Medicines assisting Expectoration, which discharge by coughing, the gross Chyme, commonly called Phlegme, and acide watry superfluities of the Blood, lodged in the Bronchia, and adjacent Cells: upon this account Medicines taken into the Mouth, may distil down the sides of the Wind-pipe and impart their opening, inciding, and detergent Particles to the gross Phlegme, and do open, incide and relaxe their gross clammy Body, and render them fit for Excretion; and by irritating the nervous and fleshy Fibres of the Air-vessels, do procure the expulsion of Recrements, settled in the spongy Compag of the Lungs.

As to the First Indication in the beginning of a Consumption, fetched from Acide Recrements, apt to corrode the Bronchia and *Sinus*, in which they are lodged: Testaceous Powders may be given, consisting of Pearl, Egg-shells, Crabs Claws, or Eies, Coral, &c. drinking after every Dose, a draught of Milk-water, made of Ground-Ivy, Hyssop, Pine and Firr, Nutmegs, &c. sweetened with Sugar-Candy, which do take off the Acidity of the vital Liquor. Drops of tincture of Sulphur, and Oil, and Milk of Sulphur may be used often in a draught of a pectoral Decoction, which do countermand the acide saline parts of the Blood.

Oxymels are proper in a Consumption and pectoral Decoctions.

In relation to the crude Chyme or Phlegme, distilling into the Cavities of the Air-pipes and Cells; all sorts of Oxymels may be given, either by themselves, or mixed with Syrup of Hyssop, Horehound, Ground-Ivy, prepared with some few grains of Gum-*Ammoniack*.

Pectoral Decoctions are good, made of some of the Five opening Roots, or *Enula-Campane*, shavings of Ivory, the Leaves of Ground-Ivy, Hyssop, &c. strained and sweetened with Syrup of Maiden-hair, Hyssop, or Sugar-Candy.

Medicines made of Garlick, either by Decoction, or in Syrup, or Con-dited, mixed with other mild Pectorals, are very beneficial to help Expecto-ration, if a Consumption be not attended with a slow, or Hectick Fever, which doth Indicate cooling Emulsions, &c. made with the cooling Seeds, and Almonds, sweetened with Sugar-Candy; as also Milk-waters, made with temperate Pectorals, to which may be added in a small quantity, Ma-gistral Snail-water, mingled with prepared Pearl, and Sugar-Candy.

The Third Indication of a Consump-tion, is satisfi-ed with clean-sing, drying, and consolida-ting Medi-cines.

The Third Indication in a Consumption may be satisfied with cleansing, drying, and consolidating Medicines, as vulnerary Decoctions prepared with Pectorals; As also Conserve of Roses, Flower of Brimstone, and some few drops of the most pure Oil of Turpentine, made into an Electuary of a thin consistence, with Honey of Roses strained, and Syrup of dried Roses.

In this case Conserve of Roses, Powder of Fox Lungs, mixed with some few drops of Tincture of Sulphur, and Syrup of Jujube may be advised with good success.

Trochiscs

Trochifces may be prepared with Powder of Bugles, Sanicle, Ground Ivy, Flower of Brimstone, penidiate Sugar, juyce of Liquorice diluted with Snail water.

Tablets may be made of Powders of Prunel, Flowers of Red Roses, Flower of Brimstone, Ladies-mantle into Tablets, with dissolved Sugar, boiled to a due consistence,

Pills may be formed of Powder of Liquorice, Red Roses, Gum Arabick, Tragacanth, Olibanum, with Balsome of Tolu, Peru, &c.

Die t-drinks made of China, Sarza-parilla, and some *Lignum Sanctum* (if there be no Heetick Fever) Saunders, shavings of Ivory, and Harts-Horn, Raisons of the Sun, let them be infused, and boiled according to Art, and strained, and a little sweetned with Sugar-Candy.

Balsome waters may be made with Turpentine, dissolved with Oil of Tartar, Roots of Iris, Enula-Campane, the Leaves of Ground-Ivy, Hysop, White Horehound, distilled in *Balneo Marix*, with Coltsfoot-water and *Malaga* Sack, which may be taken in a few spoonfuls, with any pectoral Decoction, or Syrup of Hysop, or Ground-Ivy.

Suffumigations may be also administred in the beginning of a Consumption, by reason the Fumes are received into the Lungs with the Air, to dry, open, strengthen, and preserve them from putrefaction; And to this effect, take the Leaves of Hysop, Ground-Ivy, Sanicle, Bugles, Enula-Campane, Red Roses, Red Saunders, and boil them in Water, and receive them into the Mouth by a Funnel.

And dry Suffumigations, made of Balsamicks (and sometimes of sulphureous Medicines) as *Olibanum*, *Benioin*, White Amber, Gum-*Guaicum*, Flowers of Red-Roses, Red Saunders, Balsom of *Tolu*: As also of Gum of Ivy, Mastick, Frankincense, Flower of Brimstone, the Leaves of Sanicle, Ladies-Mantle, Ground-Ivy, &c. which are good to dry up the Recrements discharged into the Cavities of the Bronchia and *Sinus*, and to strengthen the loose Compage of the Lungs.

Sometimes in great Cases, Fumes of the Flower of Brimstone, *Olibanum*, Frachincense, Styra, White Amber, and a little of prepared Arsenick, may be received into the Lungs with great benefit, to dry and heal them in point of a Consumption.

Empyricks do advise parts of prepared Arsenick, to be put into a Pipe, and the Fume to be received into the Tabide Lungs, after the manner of Tobacco, which hath been done with good success.

But in a deplorable and desperate Consumption these Fumes cannot be advised, as much intending the Heetick Fever, the sad companion of an Ulcer of the Lungs; wherefore its best in such cases to advise Emulsions, Asses Milk, and Milk distilled with Pectorals and Snails, and a slender Diet of White Posslets, as made of a small quantity of Beer, whereby the Milk is not wholly turned into Curd; and Water-gruel, Barley-gruel Barley-Creme, and thin Panada, &c. and also Syrups of Maidenhair, Liquorice, Coltsfoot, and the like, which contemperate the *Phlogosis* of the Lungs, and help Expectoration. Draughts of Black Cherry water, and of Coltsfoot, and Red Poppy, and Cowslips, may be given often to procure Rest, which giveth ease and refreshment to the decayed Patient.

Distilled Water made of Green Blades, or Ears of Corn, mixed with Snail-water, and Syrup e *Meconio* are beneficial in Heetick Fevers.

Barley-water boiled with the parings of Pippins, Pearmains, and conditioned Eringo Roots, Raisons of the Sun, adding a little Liquorice at last, and some double refined Sugar may be used instead of common Drink.

CHAP.

CHAP. LVIII.

*Of the Spitting of Blood.*Spitting of
Blood.

HAVING discoursed of a Cough and Consumption, it may not be improper now to speak of Spitting of Blood, as a disease near akin, and often terminating into it.

The cause of
Spitting of
Blood.

The fine Compage of the Lungs made up of many greater and lesser Tubes, and *Sinus* (into which the Air hath a free play to and fro,) is shaded with variety of Arteries, and Veins, as so many Channels, importing and exporting Rivulets of Blood in various Mæanders; whereupon this Fermenting Liquor, as hurried with an unkindly Torrent, when it is rendred disordered, by a great Effervescence, flowing from highly Fermentative Heterogeneous Principles, endeavouring to subue each other by hot disputes; so that the Blood is not regularly received by the extremities of the Veins, in order to be conveyed into the Heart, but is transmitted through the terminations of the pulmonary and Bronchial Arteries, into the substance, and afterward by secret pores into Cavities of the Bronchia, and adjacent *Sinus*, thereby irritating their nervous and fleshy Fibres, by contracting the spaces of the Air-vessels, to eject the troublesome Blood, by an impetuous motion of expired Breath (commonly called a Cough) into the Mouth, whence it is thrown out of the folding doors of the Lips by Spitting.

About this troublesome, and sometimes fatal disease, as a fore-runner of a Hætick Fever, and a Consumption, three considerables are worthy our remark. The First is by what Vessels this unnatural Flux of Blood is transmitted into the inward recesses of the Lungs. The Second is, into what place it is conveyed. The Third, is the manner how it is expelled out of the Lungs.

Various Fer-
mentative
Recrements,
vitiating the
bounty of
the Blood
and hindring
its Motion.

The Blood is enraged by a tumultuary agitation, and great Effervescence, as clogged with various Fermentative Recrements, whereby it is despoiled of its natural, mild, intestine Motion, and not to be carried, according to the rules of circulation, into the Origins of the pulmonary Veins, to be conveyed into the Left Chamber of the Heart; Hence the Blood being disordered by an unkindly Ebullition, quitteth its wonted Channels of the Veins, and is imparted by the Extremities of the Arteries, First into the extremity, and body of the Bronchia, and their membranous vessels, and from thence by small Ducts (opened by Heat and fierce Motion) into the spaces of the Air-Vessels; the Blood also may have an eruption into the cavities of the Lungs, when the Sanguiducts are lacerated by any contusion, or corroded by acide vitriolick Recrements, confederated with the Blood; whereupon it floweth in a greater stream than ordinary into the Cylinders, and Cells of Air, and is thence protruded by the motion of the circular Fibres, lessening the Cavity of the *Aspera Arteria*, into the larger apartment of the Mouth.

The Spit-
ting of Blood
is sometimes
caused by
Laceration,
and other
times by the
corrosion of
the Blood-
Vessels of
the Lungs.The thin and
sharp indis-
position of
the Blood, is
a cause of
Spitting it.

The various indisposition of the Blood concurrerh most chiefly to the Spitting of it, either when it is very thin and sharp, as affected with acide saline Particles, so that when it is carried out of the confines of the Arteries, into the Interstices of the Vessels, it opens the secret passages, or corrodes the tender membranous Compage of the Bronchia and *Sinus*, and floweth into their Concave Surface, making a kind of lake in them.

Another

Another Discreasy, productive of Spitting of Blood, is when it is associated with gross chymous parts, apt to coagulate, so that it cannot be entertained out of the substance of the Lungs, into the small extremities of the pulmonary Veins; whereupon it passeth more readily through the relaxed Pores of the loose Compag of the *Sinus* and Tubes of Air, into their more ample Cavities, which being sensible, by reason of many nervous and carnos Fibres, are aggrieved by the load of Blood which they throw up by their frequent Contractions into the Cavity of the Mouth.

Another Discreasy of Blood is its grossness, producing this disaffection.

And Spitting of Blood doth not only proceed from its ill affection, but from the indisposition of the Bronchia, and Vesicles, as having a loose Compag, so that a quantity of Blood being lodged in the substance of the receptacles of Air, is squeezed through the enlarged Ducts, by the vigorous contractions of the fleshy Fibres in a great fit of Coughing; or the Blood is transmitted into the spaces of Air-vesicles, in a laceration of the Vessels, in violent motion of the Lungs, in loud Talking, or straining of the voice in Hollowing, or in the extravagant motion of the Body, heating and attenuating the Blood, or by hastening its circuit into the vessels of the Lungs, made by the strong motion of the Muscles in running, riding, leaping, and the like.

The indisposition of the Bronchia, and Vesicles, cause Spitting of Blood.

The *Aspera Arteria* is shaded with many Divarications sprouting out of the Bronchial Artery; and the Membranous *Sinus* are beset with many branches (springing from the pulmonary Trunk) whereupon the Blood flowing into the Cells, and the adjacent Bronchia, is derived from the extremities of the pulmonary Arteries; but the vital Liquor protruded through the pores of the Wind-pipe into its Cavity, cometh from the terminations of the Bronchial Artery; and also in a small quantity, from the Ducts of the numerous Glands, closely confining on the *Aspera Arteria*, and its branches; in this case a little Blood mixed with Spittle, is thrown out of the top, or somewhat lower, out of the *Aspera Arteria*, without any Cough, which is effected two or three times in a day, by the gentle Contractions of the fleshy Fibres belonging to the Wind-pipe; this Blood doth not come out of the body of the Lungs, by reason it hath no mixture of Air, as not being highly florid or frothy; This disaffection is not dangerous, though it continue for some Months, because it doth not threaten a Consumption, as not derived from the pulmonary Vessels.

Spitting of Blood doth not always proceed from the Lungs, but may also proceed from the Wind-pipe.

As to the places into which the Blood (interspersed with Spittle) is discharged, sometimes it is transmitted into the bosome of the *Larynx*, and other times lower into the *Aspera Arteria*, which distilleth in a small proportion, out of the terminations of the capillary Bronchial Arteries.

Blood is carried sometimes into the *Larynx*, and sometimes lower into the *Aspera Arteria*. Blood is transmitted in a greater quantity into the Bronchia, and Vesicles.

But the Blood is transmitted in a greater proportion out of the extremities of the pulmonary Artery into the Bronchia, and its appendant Vesicles, often productive of an Abscess, and Ulcer of the Lungs, which sometimes disburdens a source of purulent Matter, into the capacity of the Thorax, and this Disease by the Antients and Moderns, is called *Empyema*, which is a collection of Pus and Sanious Matter in the cavity of the Breast, which falling upon the Midriff, hinders its free motion, and causeth a difficulty of Breathing.

Having treated of the terminations of the Bronchial and pulmonary Arteries, as so many ways or Channels, by which the Blood distilleth, and of the upper, middle, and lower parts of the Trunk of the *Aspera Arteria*, as so many places receptive of the vital Liquor unnaturally, flowing out of the Extremities of different capillary Arteries. I will now very briefly give you an account, after what manner the extravasated Blood is discharged out of

The Blood coming out of the bronchial Arteries, is done without a Cough.

The Blood discharged into the Bronchia and Vesicles, is thrown up by repeated Coughs.

The Prognosticks of Spitting of Blood.

The First Indication in Spitting of Blood.

the several places of the Lungs, and its appendages, because the Blood ouseth out of the Bronchial capillary Branches into the *Larynx*, where, after it hath made some small tickling in the Throat, it is insensibly thrown into the Mouth, without any discomposure of a Cough, or hawking, which is accomplished by the gentle Contraction of the fleshy Fibres, besetting the head of the Wind-pipe; But if the Blood flow out of a greater vessel (seated about the middle of the Lungs) it is conveyed into the Bronchia in a larger proportion, wherein it giveth a greater disturbance then in the top of the Wind-pipe, and growing alway frothy in the Tubes and Vesicles of the Lungs, is protruded upward in a stream with a great Cough, and force of expired Breath.

And if the Blood distil out the smaller Extremities of the Arteries, encircling the membranous *Sinus*, it is expelled in a smaller proportion, by deep repeated Coughs.

Having done with the nature and continent cause of Spitting of Blood, it may not be impertinent to speak somewhat of its Procatactick and evident causes; the First is often produced by an ill Conformation of the Breast and Lungs, as the one having a great straightness, and the other a great looseness of its Compage, which is hereditary, and this ill disposition of the Lungs, may proceed from the preceding diseases of an Inflammation, Pleurisy, a great Cough, and *Empyema*, which leave the *Aspera Arteria*, and its Bronchia and *Sinus* very weak, laxe, and subject to defluxions of Blood, into the spaces of the Air-vessels, rendring them very obnoxious to Coughs, and Spitting of Blood, especially if it be accompanied with Serous Acide Relements, and gross pituitous Blood, apt to be stagnant and troublesome to the substance of the Vessels, thereby causing it to be discharged into their Concave Surfaces.

As to the Prognosticks attending this Disease, the common people are very sensible of the danger, striking a terror into them, as it were a messenger of death; but it hath less of danger, when the blood distilleth out of the terminations of capillary Arteries, into the cavity of the *Sinus* and Bronchia, and is more fatal, when it is derived from a greater branch lacerated or wounded, letting out a Rivulet of Blood into the empty spaces of Air-vessels: And the danger is eminent in an ill habit of Body, in which the Blood being despoiled of its Balsamick quality, doth not well contribute to the cure of a solved unity of the Bronchia and *Sinus*; so that when Nature, as the Foundation, is deficient, Art, as the superstructure cannot take place, especially by reason the Lungs being in perpetual motion, as the subject of Respiration, cannot obtain the liberty of a Repose, which is a requisite condition of a cure in this diseased part.

And above all, the structure of the Lungs is very disadvantageous to a Cure when they are disaffected, as they are fine Textures, made up of innumerable Vessels, (rarely interwoven) which having lost their unity, are hardly conjoyned, as being perpetually acted with alternate repeated motions of Diastole and Systole; and if the terminations of the vessels do coalesce in a repaired union, the circulation of the Blood is very much intercepted, which causeth a stagnancy and putrefaction of the Blood, whence ensue, Inflammations, Abscesses, Ulcers, Consumptions, &c.

The Indications of this Disease are principally Two, The First to stop the Fluxe of Blood, and the Second is to shut up the wounded or relaxed Vessels.

The

The First Indication is satisfied with Bleeding in the Arm, which is very beneficial, as being near the Breast, by lessening the Blood; derived from the Jugulars, through the subclavian and axillary Branches, into the Veins of the Arm; whereupon the stream of Blood is diverted from the Right Ventricle of the Heart and Lungs.

The Second Indication of Spitting of Blood.

In the Spitting of Blood coming from the obstructed *Menstrua*, the *Saphæna* may be properly opened, as drawing the course of Blood, by the Spermatick, and Hypogastrick Arteries into the *Uterus*, to divert the exuberant course of Blood from the Lungs, by discharging it by a Vein of the Foot, and to sollicit Nature to make good the wonted current of the *Menstrua*.

The *Saphæna* is proper to be opened in the suppressed *Menstrua*.

And not only Bleeding is requisite in this case, but also cooling incrassating Medicines, that contemperate the immoderate Effervescence of the Blood, and check its over-hasty streams into the weakened Compag, or lacerated Vessels of the Lungs; and to this end Juleps, Decoctions, and Emulsions may be given.

Cooling, thickning, Medicines, are good in Spitting of Blood.

As to the wounded, or loose Compag of the Lungs (wherein the Blood-vessels are broken, or their Extremities are too much opened) astringent and consolidating Medicines may be advised.

Astringent and Consolidating Medicines are proper in broken Blood-vessels. An instance of the Spitting of Blood in this case.

A Gentlewoman being overturned in a Coach by a careless Coachman, was wounded in her Breast upon her fall against a short Post, placed at the entrance of a door; whereupon the vessels of the Lungs were so contused and lacerated, that she threw up immediately Three Pints, or Two Quarts of florid frothy Blood out of her Lungs: In order to a Cure, I first advised a Vein to be opened in the Arm, to divert the course of Blood; and after I prescribed vulnerary Decoctions, consisting of astringent, incrassating, and cooling Medicines: As also Water boiled with Emplastick, Astringent Medicines; to which Milk was added, and boiled, with double refined Sugar, which she took for her ordinary Drink.

Bleeding good in the lacerated Vessels of the Lungs.

I advised also distilled Milk, made up of Vulneraries, to be mixed with new Milk, to contemperate her hot, and repair her lost mass of Blood: And to that end I ordered Decoctions of China, Sarza-parilla, and vulnerary Astringents; and at last consolidating Medicines, which perfected the Cure, and restored her to a good degree of Health.

Distilled Milk made of Vulneraries, may be given with new Milk.

CHAP.

C H A P. L I X.

Of an Asthma.

AN *Asthma* is a high Disease, full of Trouble and Terror, as it often threatens death by a speedy Suffocation, which to prevent, the Organs of Respiration, do move in a most disorderly manner, and the Thorax is very much dilated to receive free draughts of Air into the Bronchia, and *Sinus* of the Lungs.

The description of an *Asthma*.

So that an *Asthma* may admit this description, as being a difficult, and quick breathing, attended with violent agitations of the Breast, performed most of all without a Fever.

Respiration is very necessary for the preservation of Life, as making good the circulation of Blood through the Lungs, in whose inward Recesses, the Blood is impregnated with the Spiritous, Nitrous, and Elastick Particles of Air, which open the Compage of the Blood, and render it fit for Interstine Motion, and assimilation of Chyme, into the nature of vital Liquor by comminution.

This curious Machine of Air, is made up of variety of Blood, and Air-vessels, Nerves, Lympheducts, which some way or other are subservient to Respiration, or the Depuration of the Blood and Nervous Liquor, which are much enobled by the reception of Air into the greater and less Cylinders and Cells of the Lungs.

Whereupon, if the repeated acts of Inspiration and Expiration be disturbed, and have not their regular course, the Oeconomy of Nature is very much perverted, as the motion of Blood (in which the flame of Life is conserved) is discomposed.

The errors of Respiration.

The great errors in Respiration seem to consist chiefly in Two things, First, That the Blood is not regularly injected out of the Right Cystern of the Heart, into the pulmonary Artery and Vein; or the Air is not freely received into the Bronchia and *Sinus* of the Lungs.

The cause of a difficult Breathing.

The defect of motion of Blood in the Lungs (which maketh a difficult Respiration) is derived sometimes from the depravation of the Blood, as mixed with crude Chyme, or other gross Recrements, which render the Blood apt to stagnate, so that the Lungs are forced to double and treble the acts of Respiration, to attenuate and refine the vital Liquor, by the reception of a large proportion of Air, to quicken the slow motion of the Blood when it is depauperated, as made of watry, or gross Sulphur, and fixed saline Particles, when the more volatil are exhausted.

The Air quickneth the motion of Blood.

And other times the Compage of the Blood groweth Laxe, as burdened with too great a Source of ferous Recrements, as in Dropsies, wherein the saline watry parts of the Blood, are not discharged by the secretion of the Renal Glands through the Urinary Ducts, Pelvis and Ureters into the Bladder; or when the ferous parts of the vital Liquor are not in some degree transmitted by the capillary Arteries into the Glands of the Skin, and thence discharged by their excretory Ducts; whereby the Blood groweth clogged with an exuberance of watry *Feces*, which having recourse to the Lungs, do give them the trouble of frequent repeated Acts of Respiration.

Gross Recrements, mixed with the Blood, cause frequent acts of Respiration.

Another

Another kind of Convulsive *Asthma* may be caused by a depraved nervous Liquor, infesting the nervous Fibrils of the Lungs, which being often contracted and relaxed, do hurry the Lungs with various irregular motions.

A Convulsive *Asthma* may be derived from an ill nervous Juice.

An *Asthma* also may come from the obstruction of the Origins of the Nerves, seated in the Cortex of the Brain, proceeding often from a quantity of Blood (as in soporiferous Disaffections) compressing the extremities of the Nerves, whence the intercostal Muscles play with great difficulty, making a deplorable *Asthma*.

An *Asthma* may come from the Origins of the Nerves obstructed.

Sometimes an *Asthma* may proceed from the narrowness of the Blood-vessels, as not able to give a free reception to the mass of Blood, which happens in Convulsive *Asthas*, wherein the circular fleshy Fibres being unnaturally contracted, do lessen the Cavity of the Vessels, and hinder the motion of Blood, whence ensueth a great difficulty of Respiration: other times an *Asthma* may be fetched from a great quantity of Blood, distending the Blood-vessels, which compress the neighbouring Bronchia and Sinus of the Lungs, and highly discompose Respiration, as the numerous receptacles of Air, being straightened in their Cavities, are not able to entertain a sufficient quantity of Air in one Inspiration; whereupon the Lungs are acted with double and treble Diafoles and Systoles, to make good Respiration.

An *Asthma* flowing from narrow Sanguifluents.

An *Asthma* may proceed from a great quantity of Blood.

Another *Asthma* may be produced by an ill conformation of the Breast, as affected with narrowness, hindring the free play of the Lungs in Respiration.

An *Asthma* may come from an ill Conformation of the Breast.

Sometimes it proceedeth from the Organs of motion, consigned by nature to the enlargment of the hollow perimeter of the Thorax, in order to celebrate Inspiration, made by the help of the Diaphragme, and intercostal Muscles.

The Coats are hindered in their Contractions, either in the interception of the Animal Spirits, not flowing into the Nerves of the said Muscles, caused by the compression of the extremity of the Nerves, in the ambient parts of the Brain, as it hath been hinted above in a former Discourse.

The intercostal Muscles cannot play when the animal Spirits are intercepted.

The intercostal Muscles are also hindered in their motion, in an Inflammation, caused by a quantity of Blood lodged in the Interstices of Vessels, compressing the carnosus Fibres, which doth hinder their free play, and render Respiration difficult.

The intercostal Muscles are hindered in their motion in their inflammation.

An *Asthma* also may be fetched from variety of Air, either on the tops of high Mountains, where we hardly breath in an Air not impregnated with store of nitrous Particles: Or when it is gross and stagnant in Fenny places (whose watry parts depress the nitrous) where persons affected with ill masses of Blood, labour with great difficulty of Breathing; which is also celebrated in a close hot room, and in a Church filled with a great croud of People, spoiling the Air with fuliginous steams.

An *Asthma* coming from ill Air.

The Cure of this Disease is chiefly managed by three Indications, the one in reference to the Blood, and the other in relation to the motive Organs of Respiration; and a Third in point of Convulsive motions, belonging to the disaffections of the Brain and Nerves.

The Three Indications in an *Asthma*.

If the Blood offend in quantity, a Vein is to be opened in the Arm with a free Hand; and in case of an Effervescence of the Blood, temperate Pectorals, and cooling Emulsions are to be advised.

Bleeding is proper in an *Asthma*.

If the Blood be gross, as confederated with a crude Chyme, (productives of an *Asthma*) by reason the Phlegme is thick, lentous, and clammy, it indicates attenuating, inciding, and detergent Pectorals, made of the Roots of *Iris*, *Emula-Campane*, *Asparagus*, *Dogs-grass*, *Hyssop*, *Horehound*, of

which, some may be boiled in Water; to which, Four Ounces of White Wine may be added, and being strained, it may be sweetened with Syrup of the Five opening Roots, of Hyssop, Maidenhair. A *Linctus* may be made of Oxymel of Squills, Saffron, Gum Armoniack dissolved in Hyssop water, which is good in this disaffection; as also Spirit of Hartshorn given in a pectoral Decoction.

Bleeding is good when the Blood stagnates in the substance of the Lungs.

An Instance of this Case.

Sometimes an *Asthma* may proceed from a gross Blood, as being stagnant in the Interstices of the Vessels, and afterward its motion is again procured upon Bleeding, which taketh off an Inflammation, and giveth freedom of Breathing, by making good the circulation of Blood,

An instance may be given of this Case, in Mr. Ainsworth a Dyer, who being in the Sixty seventh year of his age, was roughly treated by a rude fellow (who had more of Drink than Wit) tripping up his Heels, and breaking his Ribs by a great fall, as being a fat heavy Man; whereupon he being let blood, he seemed to be partly well for a day or two, and then was highly oppressed with a great difficulty of Breathing, and rattling in his Throat, even almost to a Suffocation, attended with an intermittent Pulse, proceeding from the gross Blood: In order to his relief, I immediately ordered him to be let Blood Twelve Ounces out of the Arm; and pectoral Apozemes, and Lambitives, made of Oil of Linseed, and Sugar-Candy; as also of several sorts of opening pectoral Syrups, and various Oxymels; and after letting him Blood the Third time, his *Asthma*, and intermittent Pulse were wholly quieted, and the Patient (God be praised) hath enjoyed his Health these many years.

Gentle Purgatives may be proper to discharge the watry Recrements of the Blood, clogging the Lungs.

In case of great store of watry Humors afflicting the Bronchia, and Sinus of the Lungs, gentle Hydragogues, may be advised with Pectorals; as also pectoral Apozemes, mixed with Diureticks, and Antiscorbuticks, which speak a great advantage in an *Asthma*, accompanied with a Dropsy, with which may be mixed Spirits, endued with volatil, as also Millepedes added to the former Medicines.

As to the Organs of Respiration, as the Diaphragme, &c. (which being disaffected) I refer you to their particular Cures.

Convulsive motions in Asthmas, may be cured by proper cephalick Medicines.

The Third Indication of an *Asthma*, relating to Convulsive motions, proceeding from an ill *Succus Nervosus*, denoteth Cephalick Medicines of distilled Waters, made of Lime-Flowers, Lilly of the Valley, Peony, the cephalick Water of *Langius*, Compound Peony, and Briony-water, dulcified with Syrup of Lime-Flowers, Lilly of the Valley, Peony; to which may be added some drops of Palsey-water, Spirit of Salt, Salt Ammoniack, Hartshorn, &c. distilled with Gum Ammoniack; Vesicatories are very beneficial in this, and all other kinds of *Asthmas*, which do much alleviate a difficulty of Breathing, which is also effected by the application of Cupping-Glasses.

O Most Good and Glorious Agent, Who shall Declare thy wondrous Works, that hath made all things in elegant Order, due Number, Weight and Measure; And hast framed the Midriffe as a moving Floor, enlarging and contracting the Breast,

an

and the Mediastine (as a Partition-Wall, dividing the middle from the lowest Apartment) And the Pleura, composed of many small Threads, curiously interwoven, and close struck, as a fine Hanging, encircling the beautiful Furniture of the Heart and Lungs, to secure their tender Compagnie in motion, against the bony arches of the Ribs, guarding them against the violent assaults of outward accidents.

Thou hast Treated the Fountain of Life, streaming in Purple and Scarlet Rivulets of Blood, through the various channels of Veins and Arteries, as so many Inlets and Outlets of the Heart, outwardly enamelled with variety of Vessels; And hast laid its secret Chambers (in the Waters) carved with divers fleshy substances, beset with many cords of Sinews (as so many instruments of Motion) and hast watered its Furrows with the streams of Life.

Thou hast formed the Lungs as a rare Systeme of Membranous Pipes and Bladders of Air, to fann and exalt the vital Liquor with its cool and nitrous Particles; and hast made the rough Trertery (headed with an admirable frame of Membranes, Muscles, and Grisles) as an Organ-pipe of Breath, modelling the Voice with different Articulations, to treat our friends in an amicable Converse; And to Speak and Sing the Great Praises of the All Wise Protoplast.

Thou that art the Light of our Eies, the Joy of our Hearts, the breath of our Nostrils, and the Essential Life, breathing into us the Spirit of Life; Inspire us with thy Holy Spirit, and quicken our Souls here in the shades of death, with the Light of thy Countenance; that in thy Light we may see Light, that by thy Grace we may participate the Glory of Everlasting Life, through Jesus Christ the Fountain of Life, and the Lord of Glory.

BOOK

BOOK III.

CHAP. I.

Of the Face.

The Face is a
fine Frontis-
piece of the
Head.

THE Face being a handsome Frontispiece (embellishing the anterior region of the highest Apartment, relating to the elegant frame of a Mans Body) doth present the prospect of a rare Landscip, drawn with Natures curious Pensil in excellent perspective, made up of many Lights and Shades, rendring this graceful Frontispiece Round and Soft, which is accomplished with variety of parts, consisting in divers shapes and sizes, and beautified with several colours (illustrating each other) and dressed with different Surfaces, some being Plane, others Convexe, and a Third Concave.

The highest part of this Frontispiece, most properly called, is the Forehead, cloathed with a plain, smooth, and white surface, and adorned with a kind of Oval Figure.

The Eyes are
two transpa-
rent Orbs.

The Parts adjoyning to the Forehead, are Two transparent Orbs, displaying themselves in various motions in their Orbites, as in proper Sphares, to give reception to innumerable Images of things (arrayed with beams of Light) placed in different positions.

The Nose is
the most pro-
minent part
of the Face.

In the middle of this delightful prospect, is situated the Nose, the Prominentest part of the Face (the most receptive of Light) shading one side of the neighbouring parts: This fine ridge is furnished with Two Cavities, as Pipes entertaining Air, perfumed with various Odors, Treating the sense of Smelling.

The Sides of the Face are grac'd with Cheeks, shaded with Groves of Hair, and beset with Roses and Lillies, as painted with Red and White (rarely intermixed) and are melted into each other by a sweet softness, making a delightful harmony.

The Lips re-
semble fold-
ing doors.

The lower region of this Frontispiece is adorned with Two Lips, shutting and opening the small apartment of the Mouth, as with folding Doors; to treat our Selves with the reception of Dainties (endued with variety of delicious Tafts,) and with pleasant Discourses, the amicable expressions of the Mind.

The ground of
Beauty.

The *Materia Substrata* of Beauty is made up of several parts of the Face, of the Bones (as a Basis) of the Forehead, and of the upper and lower Mandible, into which are implanted the Muscles of the Forehead, Nose, Cheeks, Chin, and above all, the Elevators, Depressors, Adductors, Abductors,

ductors, and Constrictors, the fine Muscles of the Lips; all which being framed in a due proportion, and decent Figure and Magnitude, and fitly conjoyned to each other, do speak the Symmetry and Harmony of parts, commonly called Beauty.

The elegancy of the Face, is a rare Systeme, composed of great variety of lineaments and proportions; adorned with different Colours, Lights, Shades, and Motions.

The Face described.

Lineaments, are the outward surface of the Face, Natures First and more rough draught, made up of longer and shorter Lines; the longer producing the chiefest part of the Face, and may be called the ordinary and plain part of the visage; and the more curious being made up of the shorter and filling lines, do give the Face a farther accomplishment; adding greater softness and tenderness to it.

The Lineaments are the rough draught of the Face.

And the draught of the Lines of the Face (being the ground of the Art of Painting) is called Designing, which being ill performed, it is impossible to make a laudable Picture, very much depending upon the good Drawing of the naked, and undisguised Lineaments, wherein you may plainly perceive what Beauty and Force there is in a good and well proportioned Design.

And there is nothing more worthy our remarque, then the last closes, the finishing Lines, which circumscribe the portraiture of the Face, and are Natures Master-piece, being drawn with wonderful subtilty, and are so fine and thin, do seem to vanish by little and little, till by degrees they convey themselves out of our sight; And here is the great Glory of Art to imitate Nature, in drawing the utmost Lines according to the Life, which ought to be accomplished with so much fineness giving the true and curious proportions of the Face in its thinner closing Lineaments, ending with a promise of other things behind. *Apelles* his Picture, which was known among the *Gracians* by the Name of *Nomecknemus*, adored for the extream and finishing Lines, which were cut off with so much subtilty, after the Life, that it seemed to stand in competition with Nature it self.

The finishing Lines are the most perfect.

And Nature hath not only graced the Visage with decent Lineaments, but hath also constituted divers measures, how one part of the Face holdeth an Analogy suitable to another; so that Beauty may be styled in some kind, a due modelling the parts of the Face, as being fitly united to each other in regular proportions; whence ariseth a mutual consent of Parts, the Symmetry or Harmony, commonly called the Air of the Face, which courteth the Eye of the Spectator with Pleasantness and Wonder; and I conceive it not altogether improbable, that Artists have borrowed Analogy and Harmony from the proportions, observable in Arithmetical Numbers, and Musick Concorde; Analogy and Harmony being nothing else but Rules and Measures of different Numbers and Sounds, agreeing in due proportions. Whereupon the Masters of Painting and Musick have borrowed terms from each other, and transferred them into each others Art, giving us to understand, that their Arts, consisting in the regular Analogy of Numbers, may mutually well supply defects in Terms and Language.

The Symmetry of the parts of the Face.

So that the elegancy of the Face may be truly styled certain Numbers, disposed in excellent order, a harmony of Parts united in a good decorum, holding as well a good correspondence with each other, as with the whole, plainly evident, because the best proportioned parts, being severed from each other, lose their former handsomness, claiming nothing worthy our Love or Esteem, but all the parts of the Face well framed and set together, accomplish a perfect Systeme, made by communion of parts with the whole, beautified

The elegancy of the Face.

beautified with the Symmetry of due proportions, of well shaped Bones fitly tied together, with proper ligaments, and clothed with Flesh and Skin, rarely enamelled with Veins, Arteries, and Nerves; and the substance of the Face, being plumped with vital and nervous Liquors, raise the Muscles, commending them to the amorous Beholder with admiration, most conspicuous in the Face; all other parts being smoothed with a kind of evenness, and the countenance only is graced with as great, as pleasant variety, made up of many prominent and concave Particles, full of Rises and Falls, as kinds of little Hills and Dales, seated in great order and decency, observing lovely proportions, and orderly distances one from another.

The Colours
of the Face.

The different colours with which the well proportioned lines of the Face are embellished, are (as I conceive) several models of Light, arising from different dispositions, seated in the Opake parts of the Face, which having roughnesses of divers Figures, cause various reflections of Light falling upon them, and do constitute great variety of colours, according to the different modes of Light.

Light alliaied
with various
Shades, is pro-
ductive of
different co-
lours.

The Face consisting of great unevennesses, which may seem strange to a vulgar apprehension, as exposed to a naked Eye, which being assisted with a Microscope, will easily discover many Prominencies and Cavities, Rises and Falls, in a Surface, which otherwise would appear to be smooth, so that many small protuberancies, placed in the *Cuticula*, and being of divers shapes, some Round, some Pyramidal, Cylindrical, Poliedrical, and divers others, from whence it may be probably conjectured, may arise a great inequality and number of Shades, in a scarce sensible part of a Physical Surface of the Face, which being mixed with Light, thereby rendreth it variously modelled; and being alliaied with faint, or deeper Shades, produceth darker or brighter colours; and therefore White is heightened with greater accessions of lucide Particles, then Pale or Yellow; and Black is deepened with stronger Shades, then Brown or Red: On this account, Nature wisely draweth a shady Veil over the brighter lines of Light, and making many refractions through different Mediums, conveyeth it through the dark Chambers of the Eye, to obscure its troublesome Lustre, which else through its free access, and brisker motion, would make strong appulses upon the tender Fibrils of the *Retina*, thereby weakening, or for a time destroying the Sensory.

Colours di-
scerned by
Touch.

And now I have endeavoured to give you an account of Colours upon Mechanick principles, as most obvious to Sense, as it is ministerial to Reason; That colours with which the Skin is beautified, are different modes of Light, depending upon the various dispositions of the Physical Surface of the Face, derived from the different Schemes of greater or smaller, more or less numerous Prominencies, and more shallow or deeper Cavities, producing brighter or fainter reflections of lucide Particles. This Hypothesis may be illustrated by the famous instance of a Blind Man, of which excellent Mr. *Boile* giveth a Narrative, which he first received from Sir *John Finch*, of *John Vermausen*, dwelling about the *Mosel*, who falling blind upon the small Pox, had so exact a Touch, that he could thereby discern various colours one from another, which he performed, when divers Fillets, Dried with White, Black, Red, Sky-colour, Green, Yellow, and Grey, were presented unto him, he distinguishing one colour from another by his most accurate Sense of Feeling: And when he was asked how he was able to discover these colours; he replied, he perceived their difference to arise from Asperities, with which Black of all colours doth most abound, affecting the Touch, as if it were pricked with the points of Needles, or some very hard Sand; next

to

to Black, White succeedeth in roughness, and after that Green, then Grey, in the next place Yellow, in the Sixth place Sky-colour, and in the last place Red, as the most smooth of all colours. And I do conceive, he did not only distinguish the several Colours by the different degrees of roughness, seated in the outward Surfaces of Bodies, but also from the various Figures of their protuberancies and depth or shallowness of Cavities, in which he might more easily satisfy his own curiosity, though not explain it so clearly to another, and therefore perhaps he forbore to give the later reason of discerning variety of colours.

Furthermore, I conceive the vital and animal Liquors, do contribute to the production of colours in the Face, as some minute Particles do step out of the Extremities of the Vessels, terminating in the inward part of the *Cuticula*, and may thence in some part be transmitted into the Pores and substance of it; whence it may receive different Tinctures from the various dispositions of Liquors, as White, from the purity of the Nervous Juyce, or loose Particles, being commensurate in Shape and Magnitude, to the pores of the *Cuticula*, may easily insinuate into it, making more or lesser extension of the Pores, according to a greater, or more sparing proportion received into them, altering the Figure and Magnitude of the Pores, and raising some part of the Surface of the *Cuticula*, causeth many Asperities, seated in the numerous minute Particles of the Cuticular Surface; and being placed in several Positions, some facing, and others in opposite ways, by which the beams of Light falling upon various prominencies, are so disposed, that they reflect the lucide Particles, not inward toward each other, but outward toward the eye of the Spectator. And these many little Asperities and Particles (of which the surface of the *Cuticula* is composed) are as it were so many small Looking-Glasses, as most ingenious Mr. Boyle calleth them, to reflect the innumerable Ideas of lucide Particles.

Colours proceeding from various Liquors.

White arising from nervous Liquor.

But next to White, the most eminent colour of the Face is Red, which proceedeth from being tinged with Blood, impelled out of the extremities of the Arteries into the *Cutis*, which as it is more or less Stagnant, giveth a blush only, or a deeper hue to the ambient parts of the Face; and this Liquor exactly mixed with saline and sulphureous Particles, entring into the secret passages and substance of the *Cutis*, swells its Dimensions, and augments its Prominencies and Cavities, and so affects them, that the Rays of Light are not so freely reflected as in White, the Red receiving a greater allay of Shades; but the more pure and florid Blood filling the pores of the *Cutis*, doth associate with its substance, and so alters the Protuberancies and Figure of the different minute Surfaces, that upon the reception of Light, they make brighter reverberations, being more sweetened with faint Shades, then the deeper Red, derived from gross and more adust Blood, which tinging the *Cutis* with a darker hue, produceth different Asperities and Depressions in the *Cutis*; in which the incident Rays, are forced to play more inward, and cause less reflections of Light, obscuring it with greater or less degrees of Shades, productive of Brown or Black colours.

Red, proceeding from Blood.

And it may seem to deserve our farther notice, how different Colours secretly embody with each other, without any intermedial colour; how the Lilly and Roses of the Face, pure White, and lively Red, do softly insinuate one into another; how various colours, the different models of Light, made by greater or less reflections upon the divers Figures of the many minute uneven Surfaces of the *Cuticula* of the Face, do curiously mixe, as well with each other, as with fainter and deeper Shades; how the
brighter

brighter colours do melt and languish into darker, giving but sweet and pleasant blushes of each other. Of this a prospect may be clearly taken in the Rainbow, in which, though there shine many several colours, yet their admirable transition of one into another so deceiveth the Eye, that they seem all one where they meet, but much different at a distance; and such is the intercourse of Colours in their approaches to each other, that there can be discovered no evident termination of the one, distinguishable from the rise of the other, in which we may clearly discern Red, to degenerate into a kind of paleness, and so the different approaching colours do sweetly court, and embrace each other, without the assistance of any intermedial colour.

CHAP. II.

Of the Nose.

The Situation
of the Nose.

THE Nose being the Organ of Smelling, is seated in the middle of the Face, as in an eminent part of the Body, the upper region to give reception to the steamy Scents, impregnating the fluide Particles of Air, which moving upward, are more readily admitted into the Caverns of the Nostrils, where they affect their tender inward Membrane, all beset with nervous Fibrils with soft Appulses, which are thence communicated to the inward Sensory of the Brain.

The outward
parts of the
Nose.

The Nose is adorned with various parts, the upper is called *Dorsum*, or *Spina*, the ridge or gibbous part of it; and the lowest extremity (joyned to the upper part, and fastened to the *Columna*) is stiled *Globulus*, or *Orbiculus*, the middle that runneth transversly from the *Globulus* to the Lip, is named *Columna*, and the lateral extream parts are called *Pinnae*, or *Alae*.

The inward
part of the
Nose.

The inward surface of the Nose is divided into two equal Apartments, into spiral Cavities, by the interposition of a Wall or *Septum*, which are composed of a various substance, bony in the upper Region, and Cartilaginous in the lower, reaching from the middle to the Extremity.

The passagea
of the Cavi-
ties of the
Nose.

And each Cavity hath Two passages seated about the middle of the Nostrils, the one leading upward to the *Os Ethmoides*, the other placed above the Palate, descends into the inward parts of the Mouth, and Fauces, by which the Air being impelled through the Nostrils, passeth down into the Mouth, and the mucous Excrements distilling through the *Os Ethmoides*, are forced into the Mouth by strong Inspiration, and spit out again with Hawking.

The Sinus
of the Nose.

In most Animals, the Nostrils are furnished with a double *Sinus*, as in Sheep, Oxen, Goats; as also in Birds. But Nature in Coneys and Hares, wonderfully sporteth it self in great variety of Nasal Cavities, of which, Two are most remarkable, and the greatest is seated on each side, near the Cartilaginous *Septum* (dividing the Nose in the middle) going in a straight course to the *Os Ethmoides*; and the other confineth near the outside of this Cavity, and is accompanied with a number of narrow long Cavities, made by thin Cartilaginous partitions, and are more open in the middle, and close on their sides and top, and more open in their lower Region, where all their

Apertures

Apertures discharge their greater or less proportions of received Air into one large common Duct (seated immediately above the Membrane of the Palate) through which the Air is carried into the Mouth near the Fauces.

The Nose may be considered, either in reference to its Structure, or to its Uses.

As to its frame, it may be not unfitly styled a curious Compage, made up of great variety of substances, as the outward and inward Skin, Muscles, Bones, Cartilages, Glands, Membranes, and all being expanded into many thin coverings, are finely enwrapped one within another, and set out with a decent Magnitude, good Proportions, and elegant Figure, clothed in White, speaking a great Grace to the whole Face.

The description of the Nose.

To omit the *Cutis* and *Cuticula*, of which I have Treated as common Integuments; the next in order are the Bones, which joyn above with indented Processes to the *Os frontis*, and below with Asperities to the Cartilages, and do render the upper part of the Nose expanded, and void of Motion, and are Three in number, Two composing the Sides, and the Third running in the middle, parteth the Cavities of the Nostrils into equal proportions, in whose upper Region may be discovered, upon a curious inspection on each side of the Caverns, a bony spongy substance, pendulous at the lower end of the *Os Cribrosum*, and fastned to the sides of the Nostrils, and not to the *Septum*.

The Bones of the Nose.

The bony sponge of the Nose.

These bony fungous Processes are lined with a Reddish spongy Flesh, whose substance being bruised by some unfortunate accident, the Blood is rendered Stagnant, whence proceedeth an excrescence, which growing more and more enlarged, may be probably conceived to be one cause of a Polypus.

The spongy Flesh of the Nose.

And I apprehend, that Nature partly designeth this spongy substance, adhering to the *Os Cribrosum*, as a receptacle of mucous Matter, to give a check to the continual fluxe of Recrements distilling from the Brain, and to prevent a constant trouble of wiping the Nose.

The use of the spongy substance.

Another design of Nature in these spongy Bones and Flesh, may be to contribute somewhat toward the modelling of the voice, because these being lessened by exulceration, or too much enlarged by an excrescence, do render the voice unpleasant, by reason of the sonorous Air, passing out of the Mouth into the Caverns of the Nose, maketh the voice harsh against the unevennesses of the spongy Bones, by disordering the due motions of the Air, which being conveyed out of the Mouth, giveth unkindly and unequal Appulses upon the *Tympanum* of the Ear.

And venereal Distempers sometimes cause a great Erosion, which proceedeth from sharp virulent Humors (spued out of the extremities of the carotide Arteries, into this fungous Flesh) which may be easily communicated into the neighbouring, middle, and side Bones of the Nose, and their natural union being violated, are liable to be exterminated the confines of the Nostrils; whereupon the *Septum* being gone, the Nose groweth flat and deformed; and the malignant Ulcers being farther enlarged, till the bones of the Nose are rendred carious, and the Face highly disfigured, a signal mark of God's disfavour, giving an opportunity to offenders, in rendring them conscious of their Guilt and Shame, to make sad reflections of their great errors in the Glass of punishment.

The Erosion of the spongy substance of the Nose in venereal Distempers.

The Bones of the Nose having been discoursed, the Cartilages offer themselves as appendant to them, and are Five in number, of which the Two uppermost are fastened to the lower end of the Bones, where they are more broad and rough, which passing downward, do incline forward, and being

The Cartilages of the Nose.

united; by degrees grow softer and softer, and at last do seem to degenerate into a Cartilaginous Ligament about the extremities of the Nose, and do constitute all the anterior part down to its termination: And about the lower end of the *Septum Osseum*, ariseth the Third Cartilage, and creepeth down all along the inside of the former Cartilages, and doth so much the more participate of the Nature of a Ligament, as it approacheth nearer to the termination of the Nose.

The Fourth and Fifth are small lateral Cartilages, joyned to the upper ones by a membranous Ligament, and are seated orbicularly, making the Margent of the Nose, and do almost encircle both the *Foramina* of the Nostrils, which are contracted and enlarged by the voluntary motion of the Nasal Muscles.

The Cartilages of the Noses of Conies and Hares.

The use of the said Cartilages.

The Nostrils of Conies and Hares are accommodated with more numerous Cartilages then those of other Animals; and have one more thick Cartilage, passing all along the middle of the Nose, and is accompanied on each side with a company of many thin long Cartilages, placed in an admirable order, as æquidistant one from another, except the next to the middle Cartilage, where Nature observeth a greater space, and all these Cartilages may be called so many *Septa*, making several partitions in the inside of the Nose, conveying Air into one common Duct in Expiration.

The Perforation of the Nose. The great Perforation which runneth on each side of the middle Cartilage.

There are only Two perforations in a Humane Nose, and divers other Animals, and are more numerous in Hares and Conies, and the like, who have one greater Perforation running along straight on each side of the middle Cartilage, joyned to the *Ethmoides*; but the other Cavities are much more contracted, and pass between the other Cartilages in a distinct course; and at last all the perforations do terminate into one common Cavity, passing all along between the Palate, and upper Mandible, and do end about the Fauces, near the entrance leading into the *Aspera Arteria*.

The Membrane of the inside of the Nostrils, is endued with a most acute Sense.

The Nose is every way in the inside encircled with a Membrane, deriving its pedigree from the *Dura Mater*, and is very much akin to that of the Mouth, Palate, Tongue, Larynx, Gullet, and Stomach, which though it doth invest the whole circumference of the Mouth, and parts contained in the Fauces (in which the same kind of substance is conspicuous) yet it doth not partake every where the same thickness, being thicker in that part of the Nostrils, where it is lodged under the *Os Spongiosum*, and is pierced with divers Perforations, through which the gross excrements of the Brain are transmitted.

This tender Membrane of the Nostrils is endued with so a acute Sense, that it is easily irritated by any offensive object, causing a more remiss, or violent Sternutation, as it is less or more molested by some peccant quality of a sensible object.

Under this Membrane is lodged a soft thin substance, which *Diemerboeck* calleth *Papilla*; *At ille, sub illa Membrana latet caro quædam tenuis, mollis ac papillosa, quasi ex multis papillulis coagmentata, quæ in hominibus valde difficulter, in vitulis aut bobus paulo facilius invenitur, quamvis non sine molestia. Hujus papillulæ parte anteriori minores, versus posteriores vero majores protuberant.*

The Papillary substance of the Nostrils, are the terminations of many minute Glands.

These *Papillæ*, of which the Learned Author speaketh, I conceive to be the greater or less extremities of many minute excretory Glands, conjoyned by thin Membranes and excretory Vessels, terminating into the Membrane of the Nostrils, through which the Nerves vent the recrements of this Liquor, into the Cavity of the Nostrils.

The

The Nostrils are also adorned with Nerves derived from the Third pair, which being transmitted through the *Foramina*, appertaining to the greater corners of the Eyes, into the inward coats of the Nostrils, do there emit many Branches of Fibrils, overspreading the inward coats of the Nostrils.

The Nostrils are endued with divers excretory Vessels, first discovered by most ingenious Mr. *Steno*. And the *Meatus Anteriores* have shorter excretory Ducts, which I conceive proceed from minute Glands, seated under the Coat in the forepart of the Nostrils, and descend into the anterior Region of the Palate, seated within the Teeth.

These *Meatus* are more obscure in Man, and more conspicuous, as being greater in Brutes, instead of these *Meatus*, Nature hath substituted a chink or aperture, running all along the Palates of Birds.

These *Anteriores Meatus*, (one being placed in each Membrane of the Nostrils, are styled the shorter, and are so very small, that they are scarce discoverable.

The *Posteriores Meatus* of the Nostrils, are found only in Sheep, which may truly claim the name of Channels, whose beginnings are derived from greater Glands, placed in the hinder Region of the Nostrils, where many minute Pipes do arise, (and afterward unite in one common Duct) taking their progress on each side of the Nostrils, and at last end their course toward their Anterior parts.

There are also a Third kind of excretory Vessels belonging to the Nostrils, and take their rise in many small Branches, on each side of the great angles of the Eyes, distilling out of the lachrymal Glands, conveyed into the Cavities of the Nostrils. These excretory Ducts are very different in various Animals. In Men also may be discovered many *Puncta Lachrymalia* (according to *Steno*) in the Margent of the Eye-lids, from whence do issue many short Ducts, terminating into the Caverns of the Nostrils.

The First Origins of these Vessels are seated somewhat different in Sheep, Calves, Hares, Coneys, which are not placed in the Margent of the Eye-lids, but somewhat more inward, and are found more deep in Birds, in which they are larger then in any other Animals, and are receptive of a Probe in the long Aperture of the Palate.

The Nose is designed by Nature for many uses, the Principal to receive Air first into its Two *Sinus*, and from thence somewhat of it is (as I conceive) transmitted through the *Os Cribrosum*, into the Ventricles of the Brain, and the greatest quantity (one part still pressing another forward) First into the Cavities of the Nostrils, and then through the *Foramina* leading into the Mouth, and afterward through the *Larynx*, and *Aspera Arteria*, into the Bronchia, and their appendant Vesicles, in order to Respiration.

The Second use of the Nose, is to receive the Recrements of the vital and nervous Liquor, which distil many ways from the Brain: First, through the Ventricles, and *Processus Mamillares*, and *Os Ethmoides*, which straineth the ferous Liquor, and conveyeth it into the Cavities of the Nostrils; and also these liquid Recrements (as I conceive) may slide down the Interstices, seated between the coats of nervous Filaments, into the *Sinus* of the Nostrils, in order to bedew the inward Membrane of the Nostrils with Liquor, which else would be somewhat dried and parched by the hot steams of the Blood, impelled out of the Lungs, and *Aspera Arteria* in Expiration into the Mouth and Nostrils.

Having given an account how the Recrements of the Animal Liquor are vented out of the Ventricles of the Brain, through the *Os Cribrosum* and out

The excretory vessels of the Nostrils,

The *Meatus* of the Nostrils of Sheep.

The excretory Vessels seated near the Angles of the Eyes.

The First use of the Nostrils.

The Second use.

of

Sneider's Opinion, how the Faces of the Blood are excreted through the terminations of the Arteries.

of the extremities of the Nerves inserted into the Glands, relating to the inward Membrane of the Nostrils, where the purer part of the nervous Liquor is secreted from the impure, which is carried through the excretory Vessels into the Cavities of the Nostrils. It may not be amiss now to present you with Learned *Sneider's* Opinion, who supposeth the Blood to eject its Fæculency out of the extremities of the carotide Arteries, through the Membrane of the Nostrils, which he calleth *Membranam anteriorm petuitariam*; which is very difficult to apprehend, how a Secretion can be made of Fæculent from the more refined Particles of Blood, through the terminations of the Arteries, and not the purple Liquor it self, to flow through them, as in a *Hæmorrhage* in the Nostrils: But to salve this inconvenience, the Learned Author maketh the minute Glands, lining the inward Membrane, to be *Opercula vasorum*, whereby the extremities of the Arteries are closed. This supposition (if true) may seem to check a Flux of Blood; but the Glands, as *Opercula*, cannot sever one part of the Blood from another; This may be performed by the Glands as Colatories, as the Blood is impelled out of the terminations of the capillary carotide Arteries, into the substance of the Glands, and then the more pure Particles of the Blood may be returned by the Jugulars, and the Recrements may be discharged through the excretory Vessels, into the Cavities of the Nostrils.

Another use of the Nose may be, to assist the Palate in modelling the Voice in the pronounciation of some Letters, which thereupon are called *Nasal*.

The last use of the Nostrils.

And last of all, the Nose is an Organ of Smelling, in giving a reception to odorous Steams (affecting the Air into its *Sinus*) thereby making Appulses upon the inward Membrane of the Nostrils, beset with numerous olfactory Nerves.

CHAP.

C H A P. III.

Of Smelling.

THE Nostrils are a rare *Apparatus*, framed of a Bony and Cartilaginous substance (immured with a White Skin) to keep the Caverns open, as so many Pipes receptive of Air; whereupon they are not only an Organ of Breathing, but of Smelling too, as their inward Recesses are encircled with a fine Membrane, made up of many nervous Fibrils (derived from the first pair of Nerves of the Brain) finely interwoven; so that the Steams, as various Effluxes of Bodies, embodying with the Air, do make several appulses upon the Fibrils (seated in the inside of the Nostrils) the proper instrument of Smelling.

Among the Nerves springing out of the *Crura* of the *Medulla oblongata*, between the *Corpora Striata*, and the *Thalami nervorum opticorum*; the olfactory Nerves have the precedence, and are vulgarly called the Mammillary Processes, endued with a manifest Cavity, and on each side behind the *Corpora Striata*, have an aperture into the anterior Ventricle of the Brain; so that these tender Nerves taking their Origin near the *Corpora Striata*, are propagated forward near the Base of the Brain, and accompanying the Mammillary Processes, do afterward pass through the holes of the *Os Cribrosum*, and emit many Fibrils into the fine Membrane, investing the inside of the Nostrils, running in many Meanders.

The curious Organ of Smelling, is composed of many Fibrils (sprouting out of the Caudex of the olfactory Nerves) rarely interwoven, and interspersed with membranous Filaments, filling up the Interstices of the olfactory Fibrils, rendring them an entire Membrane.

The nervous Fibrils, the instruments of Smelling are more conspicuous in Fish, and especially in Cartilaginous, as Thornback, Skait, Fire-flaire, having their Muscles severed from each other by many Cartilages, in which they are reposed, and guarded from outward accidents.

These Fish have a most admirable frame, made up of divers ranks of nervous Fibrils, running transversly, and originally sprouting out of the Caudex of olfactory Nerves (passing the whole length of their rare Compag) which may be clearly seen of themselves, without any lining or interposition of a Membranous substance, interspersing the Nostrils of Man, and those of greater Animals.

The olfactory Nerves being distributed into numerous Fibrils (framing a great part of the Membrane, investing the inside of the Nostrils) have a peculiar disposition, qualifying them for the sense of Smelling, as not agreeable to any other Nerves of the Brain, which are not at all affected with fumide Exhalations, making any impression upon them; whereupon it is requisite, that the sensitive Faculty and its object, should hold a correspondence in a proper relation to each other, by peculiar qualifications, else no sensation can be exerted; so that the object of Smelling is nothing else but numerous Steams, as so many Emanations, coming out of various bodies, and are several Atomes, endued with a Configuration suitable to the minute Pores of the Fibrils, making up the inward Membrane of the Nostrils:

The Nostrils are the Organ of Smelling, as endued inward with a Membrane, beset with many minute Fibrils. The manner of Smelling.

The Origin of the olfactory Nerves

The olfactory Nerves in Fish.

The ranks of olfactory Nerves are a contexture of Nerves in Fish, not interspersed with a Membranous substance, as in Man, and other Animals.

The peculiar temper of the olfactory Nerves. The relation between the Sensitive object and its faculty. The object of Smelling are the Effluxes of Bodies, consigned to the Pores of the Nerves.

as *Epicurus* will have it, *ἢ τὸ ὀσμὴν, ἢ τὸν αἶρα πᾶσι τοῖς ὀσφραίνουσιν, εἰ μὴ ὅσοι πνεῦς ἔχουσιν ἀπὸ τοῦ πνεύματος ἀποφασίζονται ἀντιμέθεσι τοῖς τοῦ αἵματος κινεῖν. Odorem non facturum ullam sui impressionem, nisi ab odora re usq; deferentur moleculæ, seu corpuscula quædam ea ratione commensurata, ipsi Olfactus sensorio, ut moveant seu afficiant illud.*

Whence it may be reasonably inferred, that the minute Bodies of Smell, and the contexture of the olfactory Organ have an especial commensuration; and the Effluxes of Bodies making Appulses upon the Skin of various parts of the Face and Body, and the Membrane of the Tongue make no impression upon them, because the Steams of Smell hold no proportion in Figure, and Magnitude with the small Pores of the said parts.

But the Atomes of Smell streaming out of various things, do incorporate with the Air, and being received into the Nostrils, produce the Sensation of Smelling; as the small odorous Bodies do agree in shape and size with the minute *Meatus* of the olfactory nervous Fibrils, besetting the Membrane, lining the inside of the Nostrils.

The causes of
various
Smell.

The variety of Smells consisting of different effluxes of Bodies, are produced by the Figures of the olfactory Object, of which some are round and smooth, making gentle Appulses upon the pores of the nervous Fibrils, whence sweet and pleasant Smells arise, and others are more or less unpleasant, as consisting of various kinds of Angles, which do more or less grate upon the *Meatus* of olfactory Filaments, furnishing the inward Filme of the Nostrils.

Hence an account may be given, why the same Smells are pleasant to some persons, and unpleasant to others, as they have different temperaments, and olfactory Organs, affected with Pores of several configurations.

CHAP.

C H A P. IV.

Of the Diseases of the Nostrils.

THE Nostrils (being a curious frame, composed of variety of parts) are obnoxious to many disaffections, to the impaired, or lost function of Smelling ; as also to a Hæmorrhage, Ulcers, Cancers, Polypus,

The diseases of the Nostrils.

&c.

The Sensation of Smelling is lessened by a Catarrh, flowing out of the Mammillary Processes through the *Os Cribriforme* into the Caverns of the Nostrils ; whereupon their inward Membrane becometh lined with a Rheume, stopping up the Pores of the nervous Fibrils, rendring them incapable to give reception to the odorous Steams.

The diminished Function of the Nostrils.

The Function of Smelling is lost sometimes by defect of the Smelling Nerves, not distributed into the Membrane of the Nostrils, of which Learned *Schneider* giveth an account in his Book *De Osse Cribriforme*.

The lost operation of Smelling, by defect of the olfactory Nerves.

This Disaffection also is derived from the defect of the Mammillary Processes, of which *Rolfinkius* maketh mention, *Anatom. lib. 2. Cap. 20. Falco burgius testatus est in quodam Tobacco-bibulo fumosissimo post mortem dissecto, papillares cerebri processus cum quadam nervorum odoratoriorum parte defuisse.*

The defect of the Mammillary Processes.

A loss of Smelling may also take its rise from the obstruction of the Origin of the First pair of Nerves, seated in the Cortex of the Brain, caused either by Humors inwardly, stopping up the extremities of the olfactory Nerves, or by an outward compression of them ; whereupon the current of nervous Liquor and Spirits, is intercepted in reference to the Smelling Nerves, inserted into the inward coat of the Nostrils.

The lost Smelling derived from the stoppage of the Origins of the Nerves.

Another Disaffection (to which the Nostrils are subject) is an Hæmorrhage, in which a Flux of Blood is transmitted from the carotide Arteries, propagated from the *Dura Mater*, and terminating into the inward Tunicle of the Nostrils.

The Hæmorrhage of the Nostrils.

An Hæmorrhage may be either derived from a great quantity of Blood proceeding from Aliment, or by suppressed Hæmorrhoids and *Menstrua* in Women ; or from its Acrimony, or thinness ; whereupon the Purple Liquor being disordered by great motion, or the heat of the Sun, and the like, Nature dischargeth its troublesome Particles, by the great carotide Arteries of the *Dura Mater*, into the smaller Branches of the Membrane of the Nostrils.

The cause of the Hæmorrhage.

Sometimes an evacuation of Blood by the Nostrils, may be called critical, speaking a great advantage to the Patient, when a Concoction being accomplished, the more impure parts of the Blood being secernd from the more pure, are discharged by the terminations of the carotide Arteries, into the Caverns of the Nostrils, accompanied with the alleviation of the Disease.

The critical Hæmorrhage of the Nostrils.

An extraordinary Hæmorrhage in the Nostrils, may also be produced by the carnos Fibres of the carotide Arteries (convulsed by an ill affected *Succus Nervosus*) whereupon the Rivulets of Blood are much hastened by the frequent unkindly Systoles of the soporal Arteries, violently squeezing the Blood out of the *Dura Mater* into the inward Coat, and thence into the Caverns of the Nostrils.

The Convulsion of the carnos Fibres of the carotide Arteries, produceth an Hæmorrhage of the Nostrils.

Dr.

An Instance of
the said He-
morrhage.

Dr. Willis giveth an instance of this Case in a Gentleman often afflicted with a great Flux of Blood through the Nostrils. *Attamen (ait ille) quod res fuit, sæpius in die persentiscebatur in corpore suo aliquid, modo sursum modo deorsum, sub flatu specie confestim obrepere, & plerumque motus istius tendentiam, sanguinis e naribus, aut Hemorrhoidibus sequebatur: hinc ut facile concludere esset, vasorum sanguiferorum Fibras, quibus contrahuntur illa, motrices spasmō effectus, sanguinis fluxum, ut dimissum, tenuem, huc illuc inordinate corripuisse, & subinde in eruptiones Compulisse, quod item facilius evenit, in quantum vasorum ora laxa & debiscentia, cruorem ad ea compulsam absq; remora debita effluere sinebant. Ætiologiam hanc ratiendi methodus instituta, quatenus tali supposito innitens feliciter successit, plane comprobet: nam S. M. & Medicamentum in usu deinceps omisso, præscripti usum pulveris sequentis, cujus dosim sexta quaque hora cum Julapio sumebat idoneo.*

R. Pulv. Rad. Paon, Coral. R. Margarit. pp. Ca ʒi. oculor Canc. lapid. Hamat. an ʒss. F. pulvis Dos ʒi.

R. aqu. Cerasor. nigr. ʒviii. meliss. Cinnamon Hordeat, an ʒii. Theriacal. ʒi. Syru. e Coral ʒiʒ.

Ceterum præcepi ut ligaturæ quibusdam locis ea ritu constanti, & subinde aliis pro data occasione, tum ad sistendum; tum ad intercipiendos vasorum Spasmos adhiberentur: atq; hujusmodi remediis sine ulla morbi recidiva brevi convaluit.

The Cure of
the said He-
morrhage.

As to the Cure of an immoderate Torrent of Blood out of the Nostrils, it denoteth a Vein to be freely opened, to divert the mass of Blood from the Head; and if the Blood be acrimonious, hot and thin, it is to be countermanded by dulcifying, cooling, and incrassating Medicines, made up of Electuaries, composed of Conserve of Roses, Roots of Cumphrey, powder of Steel, Eies of Crabs, Coral, Bole-Armenick, Dragons Blood, made up into the consistence of an Electuary, with Syrup of Red-Roses, drinking after it a draught of a Julep, prepared with the distilled Water of Frogs Spawn, or the Buds of Oak, and Water of Cinamon, Distilled with Barley, sweetned with Syrup of Water-Lillies, adding to every Dose, Twelve or more drops of liquid Cydoniate laudanum.

The applica-
tion of Cup-
ping-Glasses.

In this case Juyce of Plantain, Nettles, Purslain, or any other incrassating, or cooling Juyce, may prove very beneficial.

Cupping-Glasses applied to the Shoulders, Hypochondres, and above the Feet, Ligatures of the Limbs; as also dipping them into cold Water, do incrassate and cool the Blood, and intercept its motion into the Head and Nostrils.

A Cataplasme may also be applied to the Forehead and Temples, made up of Bole-Armenick, Dragons Blood, Sealed Earth, Frankincense, Mastick, with the White of an Egg, the Juyce of Plantain, and Nightshade, &c.

A Sponge dipped in cold Water or Vinegar, may be often applied to the Forehead, Temples, and round the Neck, with good success, as cooling and thickning the Blood, and hindring its current in the carotide Arteries toward the Head.

Also Pellets may be composed of Frankincense, Aloes, Spider-webs, and the Hair of a Hare, mixed with Juyce of Plantain, and Cotton; and often put into the Nostrils.

The Nostrils labour sometime with a simple Ulcer, coming from sharp Humors mixed with the Blood, and carried by the carotide Artery, implanted into the inward coat of the Nose, and this Disease being not well Treated according to Art, often degenerates into an inveterate sordid Ulcer (proceeding from virulent Matter, often found in venereal Diseases) called *Ozena* by the Antients, and is accompanied with a great pain and a fætide Smell.

As

As to the Cure of an Ulcer, Decoctions may be used, made with *China*, *Sarsa*, *Guaicum*, *Sassafras*, sometimes mixed with Purgatives, and other times with Alteratives, as the Tops of Pine, Firr, Scorby Grasse, Watercresses, which do sweeten and contemperate the mass of Blood, if the cooling Seeds be added to them.

The Cure of the Ulcer.

Bleeding may be very proper in a Plethorick Body, effected by a Lancet, or by the application of Cupping-Glasses with Scarification.

And after inward Medicines have been advised, Topicks may be used, of drying, cleansing, and consolidating Medicines, which satisfy all the indications of an Ulcer.

Aqua Aluminosa Mag. as also Plantain distilled with Aloes, in which a little *Mercury Dulcis* is dissolved, as Medicines prepared with *Cerus*, *Frankincense*, *Cadmia*, and the inward part of the Sea Onion mixed with Honey, applied to the Nostrils with Cotton or Wool.

Or an Oyntment may be made of Aloes, Myrthe, Lythargyre, *Cerus*, Lead calcined and washed with a quantity of Oyl of Roses, &c.

And if the Ulcer be very fowl and corrosive, strong, cleansing, and drying Medicines are to be used, in which a little *Unguent. Egypt.* may be dissolved.

The Cure of a fowl Ulcer of the Nostrils.

A sordid Ulcer sometimes degenerates into a Cancer, which proceedeth from the Venenate nature of the Humours, affected with a malignant corrosive disposition.

A Cancer of the Nostrils.

This disease (if come to a height) is incurable, and admits only a Palliative Cure, which may be performed with Oyl of Roses, to which may be added *Cerus*, Camphor, Juice of Nightshade, *Minium*, *Calcitis*, *Sandaracha*, &c.

The said Cancer is incurable, as come to a height.

And as a *Oxana* is an Ulcer, so a *Polypus* is a fleshy Cancrous Excrecence derived from Blood (endued with a poysonous disposition) which consisting of many Filaments and Films (interspersed with the Red Crassament concreted) is turned into a Carnous substance, fastned to the inside of the Nostrils, by many roots, or stalks.

A Polypus of the Nostrils.

After Purging Medicines and Bleeding have been administered, Topicks may be used prepared with *Venice Turpentine*, washed in Plantain water, to which may be added Juice of Nightshade, Calcined Lead, Lithargyre, *Cerus*, Tutty, Camphor, Burnt Aloes, *Mercury* sublimated, Verdigrease, with Vitriol; some of these may be made up with Oyl of Roses, and applied to the Nostrils with Wool or Cotton.

The Cure of the Polypus.

If Medicines be not prevalent to take away the Fleshy Excrecence, it may be pulled out of the Nostrils by a Chirurgical Operation, or by a ligature of Silk or Horse Hair put round the roots of the *Polypus* (if it be possible to be done) whereupon the Carnous Excrecence will be dried up, and fall off in a few days, as being destitute of nourishment, by being severed by the interposition of a Ligature from the Tunicle of the Nostrils.

CHAP. V.

Of the Eyes.

THE Eyes are seated in the highest story relating to the beautiful Fabrick of Man's Body, for the more advantageous sight of distant Objects, and are placed above the middle apartment near the confines of the Brain, as Guards to secure it from the dangerous encounters of ill accidents, and to conduct our steps in their prosecution of those due methods, instituted by Nature for the preservation and accomplishment of our meaner and more excellent parts and functions both of Soul and Body.

A description
of the Eye.

The whole Compage of the Eye is a system of many parts of different nature of Muscles, Membranes, and Humours, which do depend upon each other, and are all subservient to the noble as well as pleasant and useful function of Sight.

The Eyes may be styled Appendages of the Brain, as being affixed to the *Medulla oblongata*, by the interposition of Optick Nerves, which give them Sense and Motion, as assisted with Muscles.

The seat of the
Eyes.

The greatest part of the Eyes are lodged in fit Cavities, (resembling the segments of a Sphere) and well fortified both behind and laterally with strong Concave Bones (in which these finer Orbs sport themselves in variety of motions) perforated with many small Pores in the upper region of their Cavities through which destilleth a thin liquor from the Brain, bedewing the Eyes, (rendering them more pliable) to refresh them, lest they should be hot and parched by constant motion.

The tender and lateral regions of the Eyes are safely immured in Cavities, surrounded with the Bones of the Forehead and upper Mandible, with the upper and lower fine Integuments, with which the anterior part of the Orb of the Eye is veiled and unveiled at our pleasure.

The Eye-lids.

These upper and lower Lids are composed of a tender Skin, under which is seated the *Membrana Carnosa*, attended with a very thin *Pericranium*. The variety of parts rarely enfolded one within another, hath its extremity encircled with a *Limbus*, fringed with fine Hairs, like so many Rays emitted from a thin Cartilaginous Margent.

The lower
Eye-lid.

The lower Eye-lid taketh its rise from the margent of the upper part of the superior Mandible, and terminateth near the close of the anterior part of the Eye; This is conceived to be immovable.

The upper
Eye-lid.

But the upper proceedeth from the *Supercilium*, and is terminated near the upper region of the Eye-lid, and endued with contrary motions of opening and shutting, performed by the contractions of different Muscles.

† T. 15. F. 1.
u u.
The Elevator
of the upper
Eye-lid.

The Elevator of the upper Eye-lid † hath its origen about the Foramen of the Optick Nerve within the Chamber of the Eye, and being deduced from a thin carnos principle, is expanded into the margent of the upper Eye-lids ending in a broad thin Tendon: This Muscle being contracted, lifteth up the Eye-lid by drawing it into diverse wrinkles, by which the Eye is laid open and bare.

The Orbicular
Muscle of the
Eye lid.

The Antagonist Muscle of the upper Eye-lid, according to Learned *Vesalius*, *Westlingius*, and *Bartholine*, is a single Orbicular Muscle, seated between the *Membrana Carnosa* and *Pericranium*, near the roots of the Nose, and taketh its origination from the inner Angle, and is carried under the lower Lid with Orbicular Fibres to the outward Angle, and afterward encircleth the upper Lid, and maketh its insertion into the greater angle of the Eye, where it began. This Muscle at the first sight seemeth to be an Orbicular Muscle, but upon a strict enquiry it may be discovered to be two Semicircular Muscles; of which the upper and greater, seated in the upper Lid, borroweth its beginning from the inner angle of the Eye, near the Nose, and passing from thence, the whole length of the upper Lid is inserted into the outward angle of the Eye, taking up the whole space between the Eyebrow and the *Limbus* of the upper Lid, and being moved downward, smootheneth the upper Lid, and covereth a great part of the anterior region of the Eye.

The Semicir-
cular Muscles
of the Eye.
The upper Se-
micircular
Muscle.

The lower
Semicircular
Muscle.

The other Semicircular Muscle ariseth with an acute origen from the side of the Nose a little below the other, and passing cross the lower Lid, and rising a little above the lesser angle of the Eye, is implanted with a broad insertion into the upper Lid, to which it exactly closeth the under Lid, by raising

sing it somewhat upward. So that these minute Semicircular Muscles have contrary motions, the Muscle of the upper Lid pulleth it down, and that of the lower a little lifteth it up, wherefore it is evident they are divers Muscles, as having distinct Originations and Insertions: And Learned Diemerbroeck hath well observed, *Quod in faciei Spasmo Cynico, sæpe inferiorem palpebram immobilem & veluti convulsam, & deorsum detractam subsistere, dum interea superior naturaliter movetur, quod fieri non posset si utraq; palpebra ab uno Musculo moveretur.*

The actions of the Semicircular Muscles.

The Semicircular Muscles perfectly closing the *Limbus* of the Eye-lids by different motions, do draw the Curtains of the *Palpebræ*, and give the Eyes a repose and retirement in the silent Night, from the frequent solicitations of troublesome Visitants, the various resemblances of visible Objects, upon which the Eyes, when we are awake, do perform a duty of attendance to give intelligence to the Brain, their Supreme Lord and Maker.

About the confines of the Eyes and forward, we meet with the *Supercilia*, being two prominent small Arches seated in the upper margents of the bones of the Eyes, and covered with a thick Skin, curiously shaded with semicircles of Hair, not so much ornamental to the Face, as serviceable to the Eyes, to receive Dust and Humors descending from the Forehead, which would else surprise the Eyes, and by rendring them uneasy, would hinder their sight and motion.

The Supercilia.

About the greater and inward Angles of the Eyes, are placed the *puncta Lacrymalia*, small Cavities more conspicuous in great Animals, and in persons given to weeping; through these small perforations flow little Rivulets in so great a quantity, upon the surface of the Eyes, that they overflow the banks of the upper and lower Lids, besprinkling the Cheeks with great drops, the sad heralds of the Mind, disguising the Countenance, and proclaiming the passionate sorrow of some importunate loss.

Most Ingenious Steno hath discovered many short Ducts arising about the roots of the *Cilia*, which hardly can be seen, unless the Membranes (when the bones of the Nose are broken) be left entire.

These Excretory Vessels creeping down on each side of the Nose do discharge a serous liquor into its Cavity, in Sheep, Calves, Hares and Conies; They do not arise exactly at the roots of the *Cilia*, but more inward, and are yet more deeply seated in Birds, in which they are larger than in other Animals, and terminate into the chink of the Palate; In Horses the Vessels are transmitted from the Eye, and are continued in the whole length of the Nostrils, and terminate into the Extremity of the Lachrymal Vessels in the Eye-browes of Men.

Excretory Vessels arising about the roots of the *Cilia*.

These Excretory Ducts may be comprised under two kinds, the one confineth on the outward angle of the Eyes, and do relate to the Glands seated in it. And the other kind of Lachrymal Vessels do discover themselves about the extremity of the *Limbus* belonging to the Eye-lids, and do tend toward, and at last creep under the Glands lodged about the greater angle of the Eye.

The divers kinds of Excretory Vessels relating to the Glands of the Eyes.

And also *Aquapendent*, and *Marchetti*, have found out two Perforations about the lesser angle, observing the same order with those of the greater.

But beside these Excretory Vessels, *Meibomius*, after a most curious search, hath discovered Fifteen more in each Eye-lid, flowing from so many minute Glands lodged in them, and terminating all round the margent of the *Limbus*, encompassing the upper and lower Eye-lids.

In the angles of each Eye easily may be discerned two Glands, the less is seated in the inward angle of the Eye, styled commonly *Caruncula Lacrymalis*, which is a thin small Gland, made up of a lax spongy substance, and some part of it is lodged in a Cavity of the first Bone of the upper Mandible, through

The Glands seated in the angles of the Eyes.

through which a Perforation is made from the Eye into the Cavity of the Nostrils. This Gland seemeth partly to be instituted for a Cover of the Cavity, passing between the Eye and Nostrils. But in the Eyes of Calves, Sheep, and Horses, this Gland is not so situated at the angle of the Eye, as to be outwardly discovered, but in its stead a Lump ariseth outwardly Membranous, and inwardly Cartilaginous, to which is appendant an oblong Gland; upon the middle of it taken longways, adjoyneth a long broad Cartilage, which I conceive, in some manner conduceth to the expansion of a Membrane, which cleanseth the Eyes of many Animals, thereby quickning the sight.

Ducts passing
out of the
*Glandula Lacry-
malis* into
the Nostrils.

Rolfinchius hath discovered Vents passing out of the *Glandula Lacrymalis* into the Nostrils, which the Learned Author saith are so large in Calves, that from thence may be transmitted a Brisle into the Cavity of the Nose.

The other Gland of the Eyes (which is called the Superior, and Anterior, and sometimes the Greater) is lodged in the smaller and outward angle of the Eye, a little above the first common Suture of the upper Jaw, about a rough chink, where it helpeth partly to fill up the orbite of the Eye.

This Gland is three times as big as that of the inward Angle, not perfectly round, but somewhat broad, and blackish, and is endued with an imperfect Circular Figure, as being unequal in its Perimeter.

This Gland in a Calf filleth up a great part of the upper region of the Eye, whose *Limbus* is divided into divers Lobes, accompanied with many Excretory Ducts, running between the Interstices of the indentments.

The use of the
Glands of the
Eyes.

This Gland (as well as that of the greater Angle, and those of the Eye-lids) is accommodated with many Arteries, derived from the Carotides, and Veins from the Jugulars, and Nerves from the second, third, fourth, and eighth pair of Nerves.

Thus having given a brief description of the Glands relating to the Eyes and Lids; it may not be amiss to speak somewhat of their uses.

The first and most common is to be Colatories of the most select Liquors of the whole Body, of which the first being Vital, is transmitted by the terminations of Carotide Capillary Arteries, into the substance of the Glands, appertaining to the Eyes and Lids, and the Blood being refined, is afterward returned by the Jugular Veins; and the other Liquor is imparted by the extremities of Nervous Fibrils inserted into the body of the said Glands, in which the Nervous Liquor being depurated, the purer part is carried by Pores into the substance of the numerous Vessels, while the recrement of the Nervous Liquor is carried into the origins of the Lymphaducts, or sometimes through the Excretory Vessels, terminating near the *Limbus* of the Eye-lids, bedewing the surface of the Eyes with a shower of Tears, which being exuberant, do overflow the confines of the Eyes, and drop down the Cheeks, or else are diverted through more secret Channels leading into the Nostrils.

The Figure of
the Eye.

Having spoken somewhat of the neighbouring and ministerial parts of the Eye, I will now come to its Integral parts.

The Figure of the Eye is round, as more fit for motion, and may be well called a Globe in a lesser model, springing from that greater of the Brain, to which it is allied by the intercourse of Arteries, Veins, and Nerves, which impart life, nourishment, sense and motion to the Eye, which may be after a manner compared to a Bulbous Root, united to the Earth by Fibres, as the Eye is conjoynd to the Brain by Nervous Fibres and Vessels. And the best instance among Bulbous Roots to represent the Eye, is that of the Onion, consisting of divers thin Coats enwrapped one within another, wherein in some sort are resembled the various Membranes of the Eyes.

I will begin with the Ambient parts, the Muscles and Membranes as the Circumference of this fine Globe, and then of the Humors, contained in the

more

more inward recesses of the Eyes: And here observing Natures Method, I will treat first of the Muscles, which are Six in number in Men, and Seven in Beasts: Four of them are named *Recti*, *quoniam rectis inserviunt motibus*, and equal as well in thickness, as greatness, and derive their beginning from the inward region of the bony allodgment of the Eye, near the holes, which give admission to the Optick Nerves, and being carried under the *Tunica Adnata*, do terminate into thin Tendons near the verge of the Cornea.

The first of the Muscles being contracted, listeth up the Eye, † and is called *Superbus*, by which we speak our pride in Supercilious looks.

The second is opposite to the *Musculus superbus* both in place and office, as depressing the Eye, and is named *Humilis* †, because the Humble have an aspect downward, attended with a modest bashfulness and respect.

The third, *Musculus Adductor*, † which draweth the Eye toward the inward angle, and is stiled *Musculus bibitorius*, the drinking Muscle, wherein the sober person maketh his measures of drinking to gratifie his necessitous appetite, whereas a Good Fellow with this Muscle indulgeth his Eye in the pleasant froliques of more free Cups.

The fourth right Muscle of the Eye (called *Abductor*) † turneth the Eye outward to the lesser Angle, and is called *Indignatorius*, the angry Muscle, wherein we express our passion in a severe withdrawing our Eye to give check to any thing offending us.

Thus much of the Right Muscles, I come now to the Oblique, which are two, of these the less in magnitude, and lower in situation †, borroweth its origen from the lower margent of the bony repository of the Eye, climbing obliquely upward to the outward angle of the Eye-lid, and terminates with a short Tendon near the verge of the *Iris*, and in its contraction pulleth the Eye obliquely downward to its lesser Angle.

The other oblique Muscle of the Eye †, being the longer and upper, hath the same beginning with the third right Muscle, and entreth with a thin body into a Cartilaginous Pully, and thence ascendeth obliquely to the upper region of the Eye, and terminateth near the end of the Tendon of the oblique lower Muscle of the Eye, and being assisted with its Pully, turneth the Eye obliquely toward the inner corner: These right oblique Muscles are truly termed *Amatorii*, the Courting Muscles, because with these Lovers Court their Mistresses with amorous Glances, the attractive Prologues to more pleasant Scenes.

And the great end to which these oblique Muscles are designed, is to enlarge the territories of the Sight, which else without these Machines of Motion would be confined to a narrow compass, as capable only to discern those Objects which directly face them. But the Eyes, with the concurrence of these Muscles display themselves upward and downward, inward and outward to treat us in their different motions, far and near, with great variety of most pleasant prospects.

These Muscles are terminated into divers thin Tendons, which are united into the determination of one expanded Membrane, called by *Columbus innominata*, because it doth not deserve the appellative of a Membrane, as being rather a Tendinous Body springing from the right and oblique Muscles of the Eyes; and this leadeth me to their Membranes, those thin Vails in-folding each other, parting the Eyes as into so many fine transparent Walls, giving reception to the visible resemblances of outward Objects.

The Muscles
of the Eye.

† T. 15. F. 3.
a. a.

The first Mus-
cle of the Eye,
is called *Super-
bus*.

† T. 15. F. 3.
b.

The second is
called *humilis*.
The third is
Adductor.

† T. 25. F. 3.
d.

The fourth
Muscle.

† T. 25. F. 3.
e.

The fifth or
less oblique
Muscle.

† T. 25. F. 3. f.

† F. 1. g.
The sixth and
larger oblique
Muscle of the
Eyes.

The first Coat
of the Eye is
called *Adnata*.

The first Membrane presented to our view, in the White of the Eye, is the *Membrana Conjunctiva*, or *Adnata*; *Quoniam ejus adminicula vicinis Oculi partibus adnascuntur*, and taketh its origen from the *Pericranium* expanded, enclosing the Optick Nerves, and the greater part of the Circle of the Eyes, and is terminated at the circumference of the *Cornea*, lest the *Adnata* being an opaque Body should shade the *Cornea*, and darken the Sight.

The *Cornea*.
† T. 25. F. 6.
b.
† F. 6. a a a.

The second Membrane of the Eye is called by the name of *Dura* and *Cornea* †, the greater hinder part being opaque, is the *Sclerotica* †, enwrapping the more considerable part of the Eye, and is terminated near the *Uvea*, and deriveth its origen from the *Dura Meninx*, and investeth the Optick Nerve; and being first implanted into the hinder region of the Eye, is afterward expanded, and groweth of a greater hardness and thickness, than the other Coat from whence it springeth: This Membrane overspreadeth the hinder and some part of the anterior region of the Eye, where it making the Black of the Eye, resembleth in substance, colour, and transparency somewhat of Horn, whence I conceive it borroweth its name of *Cornea*, and may be rasped into thin pellucide Particles or Shavings, *Perinde ac si ex laminis aliquot, seu squamis invicem compactis, constituentur*.

The Figure
of the *Cornea*.

The *Cornea* or Black of the Eye is not adorned with a perfect Spherical Figure, and is more protuberant than the *σκληρωσις*, and more enlarged forward, resembling the Segment of a Circle, or the lesser part of a Sphere, not unlike the smaller portion of a little Ball, and is somewhat of a Hyperbolical, or rather of a Parabolical Figure; but in that part which is most Prominent, it doth imitate in some degree the roundness of an Orb: But if the Conformation be made both of the *Sclerotica* and *Cornea* conjoined, a right line drawn crossways may speak the Coalition of both parts of the *Dura* and *Cornea*, and the rise of the *Processus ciliares*, and of the Circular Term, and Diameter of the *Iris*; So that the *Cornea* is not beautified with an exact Orbicular, but Parabolical shape, in which the *Radii Visorii*, being more closely united, do make brisker appulses upon the *Cornea* for the production of a more clear Sight.

The Surface
of the *Cornea*.

The surface of the *Cornea* is very smooth, and so free from all Asperities, as if it were polished by Art, for the better reception of the Visory Rays; and therefore in Antient Persons, where the moister part of the *Cornea* is exhaled, it groweth more dense and wrinkled: This disaffection is called by the *Latines*, *Caligo*, which is familiar to Aged people, and much labouring of the Jaundies; whereupon the *Cornea* is so affected with the thin Particles of Bile, that it tingeth the Visory Rays with Yellow, when they make Appulses upon the *Cornea*.

The origen of
the *Cornea*.

This Coat in its first rudiment is a fluid Body, which is derived from the more viscid parts of the Seminal Liquor, first producing a Membrane, and afterward groweth by several degrees more and more solid, by the accession of new Saline Matter, by which the Membrane at last is concreted into a kind of bony horny substance; and still upon the accession of more Saline Particles new Horny Accretions arise, producing divers *Laminae* or thin Flakes one seated above another, and so finely set together, that they seem to make one entire uniform substance, but indeed (as I humbly conceive) are composed of many thin Flakes, which may be brought off in shavings by divers Sections: These fine horny Accretions were once a thin fluid body, into which may be received many transmissions of Light, making passages every way through the pliable compage of an once liquid substance, whence it was so ordered

ordered by the various displaying of Light, that such an arrangement was made in the constituent parts of the formerly Liquid Body, that the same dispositions continued, rendring it transparent, and capable of lucid transmissions, when it afterward acquired the more solid frame of the *Cornea*, originally a fluid body, and afterward turned into a horny substance by concentered, saline and earthy Particles; This Hypothesis may seem to be confirmed by many instances of Salts (the *Materia substrata* of Glass) Jewels, and precious Stones; which being originally fluid, are afterward concentered into solid Transparent Bodies.

Salts of Vitriol, Alome, Nitre being reduced into small Particles in some proper Liquor, and then being left quiet, these scattered Saline Atomes will reunite, and grow concrete in the Liquors they are seated, by shooting themselves into Transparent Cristals adorned with fine, different, regular Figures, so that it must be always supposed, that these minute concrecent Particles may have a free play in the contiguous fluid Liquor, for the fit disposing of their parts; else the Saline Atoms in the time of their concretion, will be forced to conform their Figures to the inward surface of the Vessel, in which the Liquor is contained.

Salt of Nitre, if the Water (in which it was dissolved) be too much evaporated by boiling, and put into a Glass, the Nitrous Particles having not freedom to shoot in the Ambient Liquor into their proper determinate shapes, are unduly modelled into one rude mass according to the Cavity of the Glass; but the more remote parts from the surface of it having a greater liberty to shoot in the Liquor, are curiously formed into Transparent Concretions, dressed with prismatic Figures, which are peculiar to Nitre.

And I also conceive, that the more solid substances of Precious Stones were originally *Fluores in solutis principiis*, and are afterward Coagulated by a lapidescent Juice into harder Transparent Bodies, endued with great variety of determinate shapes.

Learned Mr. Boyle, a Person of great Honor and Vertue, giveth a Narrative of a famous Quarrey, seated near a Spring, which had somewhat of a petrescent disposition; This Honorable Author caused many solid rough Opake Stones to be broken, and thrown into the Spring of Water, hoping to find some Coagulated Juice in some finer substance, and accordingly found that in divers places, the solid and massy Stone had Cavities in it, within which all about the sides, there grew Concretions, which being Transparent, and very curiously shaped, seemed to be some finer Lapidescent Juice, that by a kind of percolation through the substance of that grosser Stone, had at length arrived at those Cavities, and upon the evaporation of the superfluous aqueous parts, or by being soaked up by the neighbouring Stone, had opportunity to shoot into fine transparent Cristals, which were so great, as to overlay the sides of the Cavities.

Thus having shewed some analogy between the *Cornea*, and divers Salts and Precious Stones, how they were originally Fluid, and afterward Concentered into more solid Transparent Bodies, produced by a fine Lapidescent Juice coagulated, and curiously modelled into various regular Figures; Now I will endeavor to demonstrate the inward Texture of Glass and Precious Stones, as they consist of many thin Diaphanous Plates, resembling the fine flaky *juxta-position*s of the *Cornea*, between whose many Interstices the subtle beams of Light may freely insinuate, and every way display themselves.

Precious
Stones are
originally
fluid.

It is generally conceived that Glass and Precious Stones have one uniform inward Compage; but upon a curious survey, they may be plainly discovered to be systems made up of many thin Flakes, so neatly conjoyned, that they may well impose upon a naked Eye carelessly viewing their close Commissures: But if you hold up some very thin clear Glass against the Light, so that the Plate it self is scarce discernible by a negligent eye, and a more curious person cannot be brought to conceive that a thin plate of Glass may be divided into many *Laminae*, which though it be contrary to the vulgar opinion, yet it hath been experimented by following the Grain of the Glass that it may be split into many fine Plates.

The Geometrical Figures of precious Stones.

And I conceive this Hypothesis may be farther proved, by diligent inspection of Precious Stones, decked with Geometrical Figures, seated in some parts of their surfaces, wherein with a quick Eye, may be discovered many parallel Commissures, shewing themselves in many contiguous edges of minute thin Plates, which seem to lie one over another, like the Leaves of a Book a little opened.

And also in Saphires and Hyacinths, it is possible to espy (by turning them divers ways to the Light) the fine conjunctions of the Flakes, and I conceive these Precious Stones will admit a splitting according to the Ducts of their Grain, which is commonly done by Artists in Diamonds, whose *Laminae* consist of parallel Plains; but if the Plains of the Plates run counter to each other, the Diamonds cannot be smoothly split, because the Commissures go unequally, making Angles in the body of the Stone; which I conceive, render the compage of the Diamond less Transparent and fowl (whereupon it is judged no Paragon) as intercepting the free displaying of the beams of Light within the cross Grains, and unequal running of the Commissures of the Plates.

The first rudiments of Transparency.

Thus I have attempted to give an account of the nature of Glass, Cristal, and Gemms in their first production in *Solutis principiis* as Fluid Bodies, and in their greater maturity of more solid Compage (concreted by fine saline and earthy Particles) made up of many thin Flakes, in which they hold a great analogy with the *Cornea*, and do illustrate the origen of its Transparency in a Fluid Substance, compounded in a multitude of Atoms, interspersed with innumerable minute Spaces; whereupon the most small parts of Seminal Liquor, out of which the *Cornea* is originally formed, may be easily dissociated, and put upon motion from term to term, as it consisteth of so many active Atoms, interlarded with many minute Interstices, filled with thinner substances (every way receptive of Light) the first rudiment of Transparency in the *Cornea*, wherein the transmission of Rays pass every where through its porous Compage (when it is Fluid) so that the current made by pervious impressions are afterward retained, when the *Cornea* is coagulated into divers thin Flakes, as so many saline Accretions, curiously conjoyned, whereupon the numerous rows of Parallel Plains and Surfaces (as every thin Flake hath an upper and lower Surface) are united in fine Commissures, into whose innumerable minute Pores, the subtle *Aethereal* Particles of Light may easily insinuate, and freely display themselves, giving that pleasant transparency to the *Cornea*, as well as to Glass, Cristal, Gems, and other Diaphanous Bodies.

The

The next Tunicle of the Eye hath the Appellative of *παροειδης* by the Greeks, and *Uvea* † and *Tunica uviformis* by the Latines, as being like in colour to the Stone of a Grape; but I humbly conceive that it hath received this denomination, rather from its orbicular Skin, as a Vesicle, encircling a transparent Liquor, not much unlike that of the aqueous Humor of the Eye; By others this Membrane is called *χερειδης*, as resembling the Corion in the divarications of Arteries and Veins, finely enameling this Coat; which taketh its rise from the *Pia Mater*, and encompasseth the whole circumference of the Eye, and its upper region is for the most part affixed to the *Sclerotica*, by the interposition of many small Arteries, Veins, and Ligaments, or rather thin Membranes.

†. T. 2. F. 7. d.
The Third
Tunicle of the
Eye, called
Uvea.

Its inner Surface is supported by Swimming upon the aqueous Liquor, to which it is contiguous in its Concave Surface, and to the *Sclerotica* in its Convexe, and is of an orbicular Figure, as fitly complying with the round Figure of the ambient parts. Its inward Surface is beautified with one entire uniform colour, being Black in Men, Yellow in Cats, and Sky-coloured in Bullocks.

The seat of
the *Uvea*.

The neighbouring Membrane is called *Iris*, *ab Iridis Celestis similitudine*, as it is painted in its anterior Region (where it is loose in reference to motion) with great variety of colours, sometimes Black and Hasle, and other times Blew, Green, Sky-coloured; so that its outside is airy and gay, but its inside hath a more sober dress of Sables, as hung with Black, rendring all the inward chambers of the Eye dark (rightly constituted by the All-wise Agent) that the visible resemblances being clothed with the bright Rays of Light, might not confound the Sense with their over-much splendor; and to that end the Beams of Light (investing the outward objects) receive a due allay with gloomy Shades in the dark recesses of the Eye, to attemper this great gayness, before they make Appulses upon the tender Organ of Sight.

The Tunicle
of the Eye,
called *Iris*,
from variety
of colours.

This Membrane is a part of the *Choroides*, but according to *Riolan* it is a distinct Membrane, and may be separated, as the Author saith, from the *Uvea*, which he found in the boiled Eye of a Beast; but all other Anatomists are of a different judgment, holding the *Iris* to be one continued part with the *Uvea*, to which it is so firmly annexed, that they cannot be severed from each other, without offering a great violation to them: And the *Iris*, though it springeth out of the *Choroides*, as being one entire part with it, and is seated under the *Cornea*, yet it is not like to it, and Homocentrical with it, but is different from the *Uvea*, and all other Membranes of the Eye, which are whole, and entire Segments of their orbicular Surfaces; but the *Iris* being perforated in its Center, representeth a small Ring or Circle, through which the visible Images of things arrayed with beams of Light, are darted into the transparent humors of the Eye, and at last make Appulses upon the *Retina*.

The Pupil of the Eye † is a Perforation drilled through the middle of the *Iris*, and is oblong, or oval in Brutes, but orbicular in Man, making a little Circle about the Center of the greater Circle of the *Iris*, and is affected with various obscure motions, whereby it is gently dilated and contracted, according to the reception of the fainter, or brighter Rays of Light.

†. F. 25. F. 7. b.
The Pupil of
the Eye.

The Pupil is supported, as floating upon the watry Humor of the Eye, and is enlarged as it approacheth nearer to the *Cornea*, which is occasioned in shady places, and early in the Morning, and late in the Evening, wherein the Pupil is dilated to give a freer reception to the more obscure beams of Light.

And as the Pupil maketh its retreat inward, toward the aqueous Humor of the Eye, it is recollected by narrowing it self to deny admission to the too troublesome address of the brighter beams, into the chambers of the Eye.

The various
dimensions of
the Pupil.

And the Pupil is not only enlarged, to give a free access to fainter, and lessened to give a denial to over-bright Rays, but with them to give a reception also to the visible resemblances of outward Objects, the one near, and the other remote; while we view the nearer, the Pupil is contracted; and when we see the more remote, it is dilated, which is occasioned (as I humbly conceive) by reason the nearer object is presented to the *Cornea* and Pupil in a greater Cone; whereupon the Pupil is contracted, that the Rays of the greater Cone might be the more collected, and formed in such a due proportion, by the Coarctation of the Pupil, and thence transmitted through the transparent, to the more opake part of the Eye, that the more obtuse Cone of the near object being reduced to a point, by the contraction of the Pupil, may make a more sensible Appulse upon the *Retina*: But the greater distance of the other Object rendreth the Cone more acute; whereupon the Pupil needeth no Contraction to lessen the Cone of the more distant Object.

The motion
of the Pupil.

The Dilatation and Contraction of the Pupil, according to a regular course of Nature, are gentle and easy motions; and if they be celebrated with too great force and quickness, they offer a violence to the adjacent Membranes, which being of most acute Sense, are afflicted with pain in the over-hasty motion of the Pupil, as it is very evident, when we have conversed long in the dark, and are exposed of a suddain to a radiant Sun-shine, which being freely and suddainly darted through the enlarged Pupil, it is immediately forced by a violent Contraction, to give a stop to the immoderate incursion to the importunate Sun-beams, whence ariseth a violent pain in the Eye.

The Pupil hath a different Magnitude, as the circumference is greater in some, and more narrow in others. They whose Pupil is naturally dilated see more confusedly, by reason the visible object is presented through a greater Perforation with an obtuse Cone, which maketh a faint Appulse upon the Organ of vision: But they on the other side have a more clear Sight, who are endued with a less Pupil, in which the Rays of Light (enwrapping the visible Image of things) passing through a small *Foramen*, are more collected and united, and presented in a point, and being transmitted through the Diaphanous parts of the Eye, at last make a more brisk Appulse upon the *Retina*.

And the *Iris* in several persons hath larger or more small Perforations, making greater or less Circles in the Pupil of the Eye, through which a more free or sparing proportion of Light is received into the transparent parts of the Eye, whence ariseth variety of Sight; They who are endued with a dilated Pupil, see best in the Night, and Shady places, and are offended in the Day with bright Rays of Light, which entring through a great *Foramen* of the *Iris*, give disturbance to the more tender parts of the Eye, confounding the Sight; And they who have a narrow Pupil, are less discomposed in the day, with the bright beams of Light, which being more sparingly entertained through a narrow circle of the Pupil, give orderly and fair Appulses upon the *Retina*.

T. 25. F. 7. cc.
The Processus
ciliares.

The *Processus ciliares* are so styled from resembling Hairs seated in the *Limbus*, or Margent of the Eye-brows. These rare Processes seem to represent so many Black lines, drawn by Natures fine Pensil, making as it were divers minute Shades in the transparent part of the Eye.

These

These Processes borrow their Origen from the inward Region of the Perimeter, relating to the *Uvea*, where it resteth upon the Crystalline Humor, and are many minute Filaments or Fibres passing into, and encircling the convex Surface of the Crystalline Humor, tying it to the inward Surface of the *Uvea*; and also these fine Processes do insinuate into the *Retina*, *Aranæa*, and *Hylaoides*; and being every way twined round the Crystalline Humor, do form a kind of Ring, bespotted with Black, contiguous to the *Uvea*, in its convex circumference, and in its Concave to the *Aranæa*, with which it is encompassed as with a Girdle, and then these curious Processes are like so many Rays displayed into the Tunicle of the *Retina*, and *Hylaoides*, which by the interposition of these Fibrils, are so closely conjoyned, that they cannot be separated without the laceration of each other.

The Origen
of the Proces-
ses ciliares.

So that (as I conceive) one use of the ciliary Processes, may be as so many common Bonds of the Coats of the Eye, keeping them as well as the Humors, from starting out of their proper Sphæres, in the quick rowling motions of the Eye.

The First use
of the ciliary
Processes.

Another Use may be consigned to these Processes, to be as so many muscular Fibrils, gently moving the Crystalline Humor upward and downward, inward and outward, toward the greater and less *Canthus* of the Eye; by reason Objects presented to it, some are near, and others more distant, some are placed before, and others at the side of the Eye; Whereupon the visory Rays displayed from these diversly seated Objects, concurring in several places and points, need different refractions, that they be represented to the *Retina* in due order, as Learned Dr. *Highmore* hath well observed; *Fibræ itaque hæ Musculorum more se contrahendo & relaxando Humorem Crystallinum cui inferuntur, attollunt, aut deprimunt, donec radii ita refrangantur, ut illorum concursus sit in eadem paratela, in Retina, cum illis in oculum incidentibus.*

The Second
use of the ci-
liary Pro-
cesses

The *Retina* called by the Greeks ἀμφιβλεβερστις, ἢ τὸ ἀμφεῖν, ab amplectendo, a Latinis Reticularis, quod figuram retis amuletur, as being somewhat like a Casting-net in Figure, as many famous Anatomists will have it; But I beg their pardon, and conceive it more probable that this Coat was called *Reticularis* from the numerous Veins and Arteries derived from the *Uvea*, and branched up and down this Membrane in a kind of Network, and not from the similitude of a Pooch, by reason upon that account, the *Sclerotica* and *Uvea* may deserve the same name of *Retiformis*, as well as the *Retina*, in respect their Concave Surfaces do exceed their *Hemispherical* Surface, somewhat resembling a Casting-Net, as well as the *Retina*.

The Tunicle
of the Eye
called *Retina*.

This Membrane taketh its rise from the pulpy substance of the optick Nerve, not altogether unlike that of the Brain, which is propagated all along the inward recess of the Brain, which being dilated, is the Origen of the *Retina*, which expandeth it self so far, as to encompass in its *Sinus* the vitreous Humor, and halfe the Globe of the Crystalline, where it is united to its thin proper Membrane, called ἀσχηρῆστις; so that the *Retina* arising from the optick Nerve, and almost encircling the vitreous Humor, is inserted into the terminations of the greater portion of the Sphære belonging to the Crystalline Humor, giving a check to the exorbitant Flux of the vitreous Humor, and containing the Crystalline in its proper Sphære. And the *Retina* being firmly conjoyned round about the *Uvea*, is a kind of *Intersepiment*, parting the Crystalline Humor and the Eye in the middle, and dividing them almost into two Hemispheres, though I confess the anterior is somewhat less then the Posterior.

Having

† T. 25. F. 9. dd.
The watry
Humor of the
Eye.

Having discoursed of the containing part of the Eye, the Membranes, I will now speak of the Humors contained in them. The Aqueous Humor of the Eye † resembleth Water in thinness, transparency, and fluidness; whereupon it having no proper Coat to determine its minute agile Particles (ever disposed to motion) is quieted and confined within the more solid terms of the neighbouring parts of the *Iris*, and *Cornea* above; and below by the *Araña*, and Crystalline Humor.

According to *Riolan*, the Aqueous Humor floateth about the Vitreous, being also seated in the lower region of the Eye; but it is somewhat difficult to understand, how the watry Humor should be transmitted through the more solid parts of the *Araña* and Crystalline Humor, to the Base of the Eye; wherein in a disaffected Eye, is sometimes found a Humor more thin and fluide then the Vitreous, but more Dense and Viscide then the Aqueous; exstilling from the Vitreous Humor through its broken Tunicle, and this Humor may be somewhat attenuated by the warm ambient Air.

The Configur-
ation of the
Aqueous Hu-
mor of the
Eye.

The Aqueous Humor is excentrick to the Orb of the Eye, and hath no Figure of it self, but receiveth its configuration from the impressions of the more solid adjacent parts, the concave Surface of the *Cornea* and *Uvea*, make the anterior part of the Aqueous Humor convex, and somewhat orbicular, and the Convex Surface of the Crystalline doth render the inferior part of the Aqueous Humor Concave.

This watry Humor of the Eye is called by *Avicen*, An Excrement of the Crystalline Humor; Whereupon, when it is evacuated in wounds of the Membranes, relating to the Eye, and the wounded part being healed and closed up, the Aqueous Humor is restored again.

Galen giveth in his First Book *De Symptom. Causis*, and the Second Chapter, an instance of a Child, wounded with a Bodkin in the Pupil of his Eye, through which all the drops of the Aqueous Humor trickled down the Eye, like so many Tears; and the wound being cured, the Aqueous Humor was restored, and the Child recovered his Sight. Of the like disaffection *Hildanus* giveth examples in his First Century, and Twenty First Observation.

I conceive the repair of the watry Humor, when evacuated in wounds of the Eye, doth not proceed from the Crystalline Humor, which being more solide, is nothing akin to it, and therefore cannot propagate this thin fluide Excrement (As *Avicen* would have it) through the *Araña*: Again, if this Aqueous Humor be an Excrement of the Crystalline Humor, it must have some proper Ducts to discharge it, when redundant, which can no way be discovered in the Eye; I conceive it more probable to derive the repair of the Aqueous Humor from the Lympha of the Blood, distilling out of the terminations of the Capillary Arteries inserted into the *Uvea*; and when this Aqueous Humor shall grow exuberant, it may be returned by the Capillary Veins.

The use of
the watry
Humor of the
Eye.

The use of the Aqueous Humor of the Eye may be to support the *Cornea* and *Uvea*, and the Crystalline Humor, which being copious and well qualified in young persons, rendreth the *Cornea* and *Uvea* so plump, that its Surface seemeth too smooth and shining, as it were polished by Art; but in old Men the Aqueous Humor being somewhat exhausted, and ill disposed, the *Cornea* groweth flaccide and wrinkled.

This Humor in its natural Constitution, is thin and transparent to give a reception to the visory Rays, which are too much refracted in this Humor, when it is over Dense, whereupon the Sight is rendred dimme, by reason Objects are presented from thence to the *Retina*, as through a Cloud.

The

The Humor of the Eye, called by some *Cristallinus* † and by others *Glacialis*, from the likeness it espouseth with Cristal or Ice, not in consistence and hardness, but in transparence and colour, as Learned *Vesalius* will have it: But with the leave of this famous Author, I humbly conceive the Cristalline Humor to be only transparent, devoid of colour, having only an apparent, and no real Whiteness, which it borroweth from the bright beams of Light, sporting themselves in the inward Recesses of this transparent Body, not hued with colour, with which if it were tinged, it would be rendered incapable to transmit various colours of visible objects (through its own Substance and vitreous Humor to the *Retina*) which though in themselves very different, would be represented under that one determinate colour, with which the Cristalline Humor is predisposed, and it may be proved by reason, that every medium of Sight ought to be denuded of all colour, or else *Intus Existens prohibet alienum*.

† T. 2. F. 9. 11.
The Cristalline Humor of the Eye.

And truly I cannot but wonder why this part of the Eye should have the appellation of a Humor (as it is commonly received by the Antient and Modern Anatomists) when it is not fluide, as being of a more solid Body then Liquors, somewhat resembling soft Wax in consistence; But I will sit down with the common denomination, rather then give a disturbance, *Quoniam usus obtinuit*.

The Cristalline Humor is not properly fluide.

This Humor hath halfe of its Orbe enwrapped with a thin Membrane, called *Aranea*, or *Cristallina*, which is extended from the upper Region to the middle, where it is united to the *Retina*.

The Membrane of the Cristalline Humor.

The Figure of the Cristalline Humor varieth in several Persons and Ages, and the orbicular protuberance is not always uniform, and is different in the same person, occasioned by accidents and age, whose defects are supplied by Art in the invention of Spectacles, which are diversly contrived with more or less prominency, according to greater or less weakness of the Sight; and sometimes they are made Concave, (which is rare) when the Cristalline Humor is too protuberant, but most persons of ill Sight are gratified with Spectacles of a convexe Figure, by reason the Cristalline Humor being naturally endued with a Prominent parabolical Figure, is often deformed in old Age, with a broad depressed shape, because the substance of the Humor being somewhat absumed, groweth wrinkled and flaccide, and more tending toward a Plane, then in young persons, who have a smooth protuberant, Cristalline Humor, well adapted to Sight.

The Figure of the Cristalline Humor.

The Seat of this Humor is placed near the center of the Eye, confining above upon the Aqueous, and below upon the Vitreous Humor, which receiveth a great part of the lower convex Region of the Cristalline Humor in its concave Surface; so that the Cristalline Humor being not exquisitely seated in the middle of the Eye, is excentrick to it, if it be strictly taken in reference to its whole Globe, and the Humor is more concentrick in its anterior Surface to the *Cornea*, to which it is excentrick, as to its lower Region.

The Seat of the Cristalline Humor.

As to the transparency of this Humor, it is a matter of as much difficulty as pleasantness, to know the cause and manner of it, which dependeth upon the Compage and Contexture of its various parts; and Bodies are more or less transparent, as they consist of more or less rare Particles: And opaque Bodies are made up of many Dense parts, so closely conjoyned, that they admit few or no thin airy, or æthereal Particles, into their ambient Region, and more inward Recesses; whereupon Bodies become more or less dark, as

The Transparency of the Cristalline Humor.

S to

they

they are with divers degrees of Density, which hinder the reception of Light, into their more compacted substance.

Learned *Gassendus* is of a different Sentiment, affirming Bodies are more or less transparent, as their parts have greater or fewer empty spaces, receptive of Rays of Light, and are more or less Opaque, as they are compounded of more or less dense Atomes, giving a resistance to, and making reflexions of the beams of Light, in which I will give you the words of the Author, making this inference after a discourse of transparent and opaque Bodies: *Sequitur denique ut inter spacium summe perspicuum, & corpus summe opacum, sunt omnes gradus perspicuitatis & opacitatis intermedii, id circo in his gradibus, nullum sit corpus adeo perspicuum, cui non mista aliqua opacitas, nullum adeo opacum, cui non aliqua perspicuitas, utpote tanquam existentibus inanibus spatiolis, nunc pluribus, nunc paucioribus Corpuseculis quæ trajecturis radiis obstant illosque repellant.* This Opinion is founded in the empty spaces of Bodies, which being more or less numerous, do constitute greater or less degrees of transparence, as receptive of more or less influxes of Light; The Learned Author farther illustrateth this assertion with divers instances; *Ait ille, cogita quam liceat facilius explicam negotium per interpositionem inanis, usi sumus superius, cum de inani differimus, similitudine tritici quod laxius, pressiusque cupit, majorem minoremque locum, in medio. Aut quemadmodum vellus manu diducentes, atque comprimentes, concipimus aerem rarefacere & addensari ac raritatem fieri, cum pili prius viciniores detrahentur a se invicem, locaque intercipientur, plura autem aut ampliora in quibus lanae nihil sit, densitatem vero, cum partes prius distantiores magis ad se mutuo accedant, locaque pauciora, minorave intercipientur.*

The Renowned Authors meaning in this (as I suppose) that the grains of Corn, as they lye more close or loose in the Bushel, are more or less extended, and affected with greater or less degrees of Rarity and Density, as they have more or less empty spaces; And so proportionably a Fleece of Wooll hath more or less Rarity, and Density, as the Hairs are more united to, or distant from each other; and as they lye more loose or compressed, have more or less intercepted spaces, which I humbly conceive, are not mere vacuities (as the Learned Author will have it;) by reason the intercepted spaces found in the loose position of Corn, and the Interstices in the contexture of Wooll, are not (as I conceive) destitute of all Bodies, but are filled with subtle Particles, as little Cells of Air, out of which it maketh a quick retreat into that common ambient Receptacle, when the grains of Corn, or hairs of Wooll run close together by a compressive force.

The Authors
Opinion of
Transparency.

And after I have given Great *Gassendus* his more profound Notions of transparent Bodies, I take the boldness humbly to offer some of mine own meaner Sentiments, wherein I apprehend much of Transparency to proceed from the different contexture of Bodies, which are more or less pellucide, as they consist of many thicker or thinner *Laminae*, placed one above another, and joyned so near together with most curious Commissures, that they seem to constitute one entire substance, by reason we are not able to discern the edges of the Commissures in the Compage of Gemms, Diamonds, Glasse, and other transparent Bodies, which do admit a splitting, according to their Grain, and Ducts of the flakes in Glasse, Diamonds, &c. and cannot be well and equally parted cross-ways against the Grain and Ducts of the Commissures, but they will irregularly break into odd pieces, and defeat the design of the Artificer.

And

And it being granted, that Jewels, Diamonds, Cristal, and common Glafs, are made up of numerous thin, and thicker conjoynd *Lamina*, and are thereupon more or less clear and transparent, as the greater or less proportion of lucide Particles (which being subtle æthereal Bodies) can easily insinuate themselves between the Commissures of the Flakes, and give a greater or less brightness to the whole laminous Body, as it is composed, and made up of more or less thin Shells, between whose joynts the beams of Light do more or less display themselves, and render their Bodies more or less Diaphanous: so that this conjecture of Transparency may have probability in solid Bodies, as framed of divers thin Plates; but the account may be different of these solid and fluide Bodies, as having many minute Particles, which may be easily separated, and have numerous little Pores, filled with more subtle Airy, or Æthereal Particles, which will easily insinuate into the inward Recesses of fluide Bodies, and pass through to the ambient parts, so that a Body less subtle than that of Air, as the smoak of Tobacco, will be transmitted through the pores of Water, which hath been often made appear to vulgar Eyes: whereupon liquid Bodies, consisting of innumerable minute Particles, are every where beset with small Pores, replenished with airy Particles, into which Rays of Light being freely darted, do give it a beautiful Transparency, which is more or less visible, as the Liquor is more or less Lymphide, caused by greater or less defæcation, from gross and earthy Particles, rendring Liquors more or less turbid; whereupon they are receptive, of more or less irradiations of Light.

The Cristalline Humor of the Eyes is formed of the transparent fluide Particles of the seminal Matter, into whose numerous Pores, fraught with thin airy Atomes, the beams of Light may make many arrangements, every way disposing them to Transparency: and though afterward this Cristalline Humor, impregnated with saline Particles, groweth somewhat more solid, yet it retaineth still more spaces, replenished with thin volatil substances, capable to receive the transmissions of Light, which by making themselves passages every way, do dispose the more solid Particles after a manner requisite to the constitution of a transparent Body: An instance may be given, That Silver in *Aqua-fortis*, or Lead in Spirit of Vinegar, have by that solution, their Particles reduced to a more fluide Form, and their substance before Opaque, is so disposed of by Art, as to make a diaphanous Solution; but if one pleaseth to make transparent Cristals, it may be observable, that Bodies once fluide, and highly affected with Rays of Light, are so ordred, that though they grow afterward concreted, yet they retain much of the First impression of transparent Bodies, as may be seen in Cristals, Ice, and also in Diamonds, and other Jewels, which I conceive are originally fluide Bodies, *in solutis principiis*, and afterward are coagulated into more solid Bodies by their petrescent Liquors.

The Vitreous Humor is so called, because it resembleth Glafs melted by an intense Fire, both in Consistence and Transparence, and is somewhat more fluide then the Cristalline Humor, and more solid and viscous then the Aqueous.

Its situation is in the lower region of the Eye, and containeth the Segments of the lower Region, belonging to the Cristalline Humor, in its *Sinus*.

The Figure is Semilunary, Concave in the upper Surface, as having greater dimensions about the middle, and terminating into Two obtuse Cones.

The formation of the Cristalline Humor.

Cones. This Humor is Convex in the lower Surface, and its whole Perimeter is encircled with a fine transparent Tunicle, called *Vitrea*, severing it from the Cristalline Humor, and boundeth its more fluide Particles, and secureth it from intrenching upon the neighbouring parts.

The Vitreous Humor deriveth its first production from seminal Liquor, which consisting of thin and fluide Particles, hath a loose Compage, easily receptive of Light, whose subtle æthereal Particles make many arrangements through its ambient parts, and more inward Recesses, giving it a clearness and Transparence, which is endued with a power to receive the Visory Rays, and transmit them to the *Retina*.

CHAP. VI.

Of Light in order to Seeing.

HAVING given you a History of the Fabrick of the Eye (as composed of variety of Tunicles and Humors, as so many Circles encompassing each other, and making up the elegant Globe of the Eye) I will now endeavour to explain the use of this transparent Orb, how its several parts, encircling each other, are ministerial to Sight, by giving us a fine *Viseto* of various images of things, as so many Pictures, consisting of beautiful Figures and Colours, arrayed with beams of Light, reflected from opace Bodies, First in right Lines, and afterward transmitted by many interfections, and inflections, making divers angles of incidence and refractions in Heterogeneous and Exentrick Diaphanous mediums of the Eye, and are at last imprinted on the Organ of Vision.

A description
of Light.

A lucid Body may be supposed a Systeme of innumerable Atomes, of which every one is acted with a most swift motion, propagated in right Lines through the ambient fluid Medium, whose Particles being free from firm connexion, are beset with an infinite number of Pores, receptive of most minute Bodies of Light, which being opposed by some solid opace Body, do recoil inward into themselves, and being confined within their own bounds, are not dissipated, as expanded by crooked lines into a fluid Body, but continue their most rapid current in a direct course, as putting by strong Appulses any Heterogeneous Body into flight, that doth not make too powerful a resistance.

The nature of
a Ray, as
transmitted
through a
Similar Medi-
um in right
lines.

An infinite company of these lucid Particles being closely conjoyned to each other, and diffused a great space in right lines, are called a Ray, which I conceive to be made, when the Medium is Homogeneous (as qualified with the same Figure, Magnitude and Solidity) pervious by innumerable similar Interstices,

The reflexion
of Rays in an
opace Body.

But if the Medium be disposed with Particles of a different shape, size, or too great a Consistence, or too narrow Pores, (which do not readily, or not at all receive the Atomes of Light) the freedom of their motion in right Lines is impeded, whereby they are forced to form Angles; so that they make a direct

direct retrograde motion in Reflection, or an oblique Current in Refraction.

Rays being a great company of continued lucid Particles (to speak Philosophically) are adorned with a Prismatick or Cylindrical Figure, by reason many minute Bodies being seated in the Surface of a greater or less Luminary (from which a Ray is propagated) are carried from their prime place or Base, by pressing right forward through a contiguous Body, which complieth in Figure to the shape of the impelling Body, which is long, small and round (founded originally in the Surface of a lucid Orb) or if you please, it may be conceived somewhat to resemble a Cylinder, or Prism, as some Mathematicians will have it; or these Rays may be described by right Lines, as they are very long narrow Bodies; And it doth not at all derogate from the Science of Mathematicks, to take their Axes or Perpendiculars to be affected with Cylindrical or Prismatick Figures.

The Figure of Rays.

Another Hypothesis relating to Light, may be this, That a Ray is propagated Hemisphærially from every point of a lucid Body, to all points of the Medium, unless it be darkened with an Opaque Body, intercepting the beams of Light.

A Ray is emitted Hemisphærially.

And by the points referring to the lucid Body, and the Diaphanous Medium, we are not to understand them, to be purely Mathematical, but most small Physical points, as minute as can be imagined; and that the most subtle Atomes of Light, moving with a most wonderful quickness, cannot be transmitted from a lucid Body, through a transparent Medium at a great distance in a moment, strictly taken, but in a minute portion of time, because we cannot apprehend any space of it to be so momentary; but some Ray may stream from any Particle of a lucid Body, into every point of the Medium, by reason the Bases or Origins of these Rays, constituting the lucid Body, (as far as we can conceive their quantity by Reason and Sense) are infinite in number, and most small in quantity, and most agile in motion; and that in every point of a lucid Body, there are an innumerable company of lucid Atomes, displaying themselves into all coasts of the Hemisphere in a most short, and almost imperceptible space of time, but not in an instant rigorously taken, which is very improbable, if not impossible, as supposing many minute Bodies of Light, which implieth a contradiction, that the Pores of a transparent Medium should receive an infinite company of Atomes of Light in the same instant.

Points relating to lucid Bodies and Mediums, are not purely Mathematical but Physical.

Rays are infinite in number, most minute in quantity, and quick in motion.

This Hypothesis may be confirmed by many familiar Experiments, and more especially by this; That in every place where the enlightened Object is seated directly opposite to a Looking-glass, a number of subtle lucid Bodies are reflected from every point of it, and conveyed to the Orbe of the Cornea, the first transparent coat of the Eye.

This Hypothesis is confirmed by Experiment.

Another Hypothesis belonging to Light, is, that its lines stream perpendicularly, as they make an impulse through the porous parts of the Medium, in right lines, either forth-right, as in Opticks, or in a retrograde course, when it encounters an Opaque Body (affecting the Medium) whereby the Rays of Light are reverberated into the contrary parts by reflection, as in Catopticks, or when they are inflected; making different Angles in various transparent Mediums, as in Dioptricks.

The various motion of lucid Rays.

The Rays make their motion in right lines in a Homogeneous Medium, and are reflected by an opaque Body, and refracted in Heterogeneous Mediums.

In a similar Medium not consisting of variety of parts, as endued with several Magnitudes, Figures, or too much Density, the Rays make their motion in a straight course, as not encountering any Heterogeneous Particles, indisposing the Medium: Whereupon the streams of Light are not diverted from their proper Motion, right forward, by the opposition of some

Opake Body in reference to reflection, or in refraction made by greater or less degrees of Density in different transparent Mediums, which is evident in the various Coats and Humors of the Eye, through which the Rays of Light being trajected, do make different Angles, and either bend to, or recede from the perpendicular; so that the reflection of lucide Rays (including Reflection or Refraction) are made in the surface of a Medium, either by the resistance of a solid Body, not receptive of Light, or by the less opposition of a transparent Medium, wherein greater or less Angles of incidence and Refraction, are formed, as the Rays of Light are represented more or less obliquely through the Air to the *Cornea*, or out of any other transparent Medium to another.

Rays make an inflection both in a Plane and Spherical Surface.

Rays are diffused into an Orbe.

An Experiment to confirm this Hypothesis.

And this Inflection may happen as well in a plane Surface, as a Sphærical; For instance, let a Ray fall upon the outside of a Plane Looking-Glass at such a point, through which Two right lines may be drawn; so that the said lines falling upon one plane Surface, What hinders the reflection of the Rays to be made in the same Plane? And by the same reason a Reflection of innumerable Rays may be made in infinite points of a Plane Opake Body; As also reflected Rays may display themselves into an Orbe, whereby all the adjacent parts are receptive of greater degrees of Light, as the Beams are doubled by Reflection, which are not mere Mathematical Lines, but Bodies affected with all kinds of Dimensions, and endued with the Figure of a Prism or Cylinder, according to the shape of the Body, from whence they take their rise.

For the better illustration of this Hypothesis, Suppose a Ray (like a Parallelogram) be represented to have its side applied to the Surface of the Glass, while the other part of the Parallelogram is lifted up above the Plane of the Glass, and recoileth in a direct progress from the said Plane; And when Nature is not discomposed in its usual and proper course, the Rays of Light do recede as little as may be from a straight stream, to which they have a natural inclination.

If a Parallelepiped be Mathematically accounted for a right Line, a reflected Ray also resembling it, may be conceived to be a right Line; and by the same reason, if a Ray be endued with the Figure of a Right Cylinder, such a one as streameth from a Sphærical lucid Body, it may be shewn to admit a Reflection, coming straight from the Surface of a dark Body; because a right Cylinder falling upon a Plane, hath its Basis and Axis so placed, that the Base doth touch the Plane of the Looking-glass, and the rest of the body of the Cylinder is obliquely elevated above the Plane; and a line being drawn from the Base of the Diameter, doth obliquely intersect a line of the Axis: whereupon it being carried through it and the Axis, a Plane is made in the Cylinders; so that through its sides two Planes may be conceived to be drawn parallel to the Axes touching the Cylinder: Whereupon it may be made evident, that the Duct of the whole Cylinder may be comprehended between Two Planes, defining the reflection of the Ray between them; and these Planes are right to the Plane of the Looking-glass; so that the said Planes perpendicular to this touching the Cylinder, run parallel to the Axis, whereupon, the same Planes become right to the Plane of the Looking-glass. Hence it may be inferred, that if the whole Radius be supposed to be a right Line, its Reflection will be made, as in a Surface, direct to the Plane of the Glass.

These received Hypotheses, or rather Maxims relating to Light, are very conducive to the better understanding of Opticks, as determining the progress

gress of the inflected Rays of Light, and the places of Images, belonging to visible Objects, and the discovery of Figures, Magnitudes, and the explication of the causes of their *Phainomena*, as agreeable to Reason and Experience. Wherefore the Figure of a Prisme or Cylinder (being Mathematically attributed to a Ray of Light) is conceived to be impelled in a right Line, (as by a most simple motion most suitable to Nature) exerting its utmost force, to promote the quick Pulse relating to the Rays of Light.

The motion of Light is made in a right Line.

From hence the progress of Rays is so far defined, as it is included within Two plane Surfaces, perpendicular to the inflecting Medium.

Here the Ray may be Treated of, as endued only with Two Dimensions, resembling as it were, a rectangular Parallelogram, seated in a Plane according to right Lines, at the Surface of the inflecting Medium.

Another Hypothesis belonging to Light, may be this; That the Ray of Incidence, and Reflection make equal Angles at the Surface of a Looking-Glass.

The Ray of Incidence and Reflection, make equal Angles.

A rectangular Parallelogram representeth a Ray obliquely, falling upon the Plane of a Looking-glass; and when the point of a Parallelogram encountering a Looking-glass, as an opake and impervious Body, cannot make its progress in a direct course, it endeavoureth to recoil back again in straight Lines, and the other term of the Parallelogram (seated in a right posture) is elevated above the Surface of the Looking-glass, if it be hindred by the interposition of a dark Body, and hath its motion carried backward in a right progress; after the Ray hath begun its reflection on the Surface of the Looking-glass by a kind of Rotation, and then it maketh good its retrograde Motion in a direct course; so that when the Ray falleth upon the plane of the Glass in a point (as Mathematically taken) it immediately maketh an Arch in its first reverberation, as deflecting from a right Line, and after some small space recovereth its regular and proper Motion, as most agreeable to the unspeakable swiftness of the most minute and subtle Bodies of Light.

The beginning of reflected Rays is made as a kind of Arch.

The Rays of Light are carried forward with an admirable Celerity, and falling in a point upon the Surface of some opake Body (not receptive of the beams of Light) are forced to retreat with great quickness, and are resisted in the beginning of their Reflexion, with the contrary motion of other beams; Whereupon the opposite Rays do impede each others progress, and make a kind of circular Motion, which I conceive is made after this manner: The Rays being impelled forward, as falling upon the Surface of an opake Body, do make first an Angle of Incidence, and as the Beams are not received into the Pores of a dark Body, they form another Angle of Reflection upon the point of the Surface, from which the Rays are beaten back, at some distance from the other Beams; so that the Angle of Incidence being conjoyned in the Center to the Angle of Reflection, doth make some part of the Semi-circle, as the Rays moving backward, are somewhat hindred by a resistance of forward Beams, which endeavour to insinuate themselves into the Pores of the opake Body, before they make a retrograde course; so that the most subtle and minute Bodies of Light, being of an active, restless temper, do perpetually diffuse themselves through transparent Mediums, and more perpendicularly forward, till they are stopped by some opake Bodies, and then they are constrained either to rest (which is inconsistent with the nature of Light) or to return by Reflection.

The manner how Rays are reflected from an opake Body.

If the inquisitive Reader do demand a Reason, when only a point of the Ray hath a renitence, and all the rest of the Line affecteth a contrary motion; This reply may be given, That the Incident Rays being acted with

A right motion of Rays degenerates into a Circular, as encountering an opaque Body.

Refraction is made in different transparent Mediums.

An Instance relating to a manner of Refraction.

A rare Medium giveth less opposition to a Ray.

The Ray is Refracted after the same manner, upon a crooked Surface, as a Plane.

a rapide Motion, are impatient of Rest, when they fall in a point upon the Surface of a dark Body ; so that it is usual in Nature, when a right Motion degenerates into a Circular, that the extream parts opposite to each other, which obey the conduct of the utmost terms, have a most nimble revolution, as the middle terms are acted with a more slow Motion, so that the extream points of the Rays do make their opposite motion with equal force, and the Rotation interceding the Incidence and reflection of Rays, is made in one point.

Having Treated of the Reflection of Rays, it follows that I should now discourse their Refraction, wherein the beams of Light falling upon a dissimilar transparent Medium, are so refracted, that the right *Sinus* of the inclination (with which the incident Rays are endued) observeth the same proportion, with which the inclination of the refracted are affected.

And its farther illustration may be thus celebrated, Suppose a *Parallelogram* representing a Ray of Light, doth fall upon the plane Surface of a diaphanous Medium, it somewhat retardeth its progress, so that the point of the *Parallelogram* entring into a different Medium, cannot proceed in a right progress, as it did in the former Medium, in which the lucid Beam did make a quicker Motion, as being of a more thin consistence.

The Point (about which the Ray makes an Angle) giveth less opposition to the incident Rays in a rare Medium, which less checketh their progress, and thereupon the Beams make less Angles, both of Incidence and Refraction ; but when the incident Rays encounter a more dense Medium, it maketh a greater resistance, and rendreth the motion of the Rays more slow, and formeth a greater Arch, both in the incident and refracted Beams.

We have Treated hitherto of a Plane Surface, now it remaineth to be considered, what sensible difference may be found, if any be incident to a crooked Surface. Suppose the inflection of a Ray be made upon a crooked Line, so that it may touch directly at the point of Incidence, and the Ray shall be refracted after the same manner, upon a crooked, as upon a right Surface ; whereupon, if you observe the great subtilty of the Ray, how little a space the point is distant from the top of a crooked Surface, it will produce no sensible difference ; and the Ray hath a quick or slow motion, as it is trajected through a rare or dense Medium, wherein it hath less or greater resistance, and maketh less or greater Angles of Incidence and Refraction, as well in a crooked as in a plane Surface.



To the Right HONOURABLE
My Lord Bennet Sherard,

BARON of LETRIM.

My LORD,



ARTS, Sciences, and Vertuous Inclinations being of a Noble Extract, and Divine nature, do hold much Analogy with our more Cælestial parts, (in which the Image of God is imprinted) and do speak great Pleasure and Satisfaction, as they are Perfective of our Humane nature in elevating our low Intellectuals, and refining our depraved Morals.

And I am much pleased in considering that Men of most Excellent parts, (who know how to value and treat the more noble Faculties of the Mind, and their precious hours) take most Delight in understanding the Causes of Things,
and

and the Wonders and Secrets of Nature; whereupon I have taken the boldness to present your Lordship with many Notions of Experimental Philosophy, deduc'd from Anatomical Dissections, wherein you may have a fine sight of the Noble Fabrick of Man's Body, in which you may see your own Structure, and admire and adore the great Artifice of the All-wise and Powerful Protoplast, and pay a duty of the greatest Thanks and Obedience imaginable to His most Glorious Name for His Wondrous Works, Evidenced in Comparative Anatomy, in viewing the Parts of Varieties of Animals, how they partake Similitude with, and Illustrate those of a Humane body, which is very useful to the advancement of Natural Knowledge, subservient to more Divine and Christian Philosophy, consisting in many salutary Precepts and sober dictates of rectified Reason (rendring us Happy) which your Lordship hath highly practiced and made you very valuable in the opinion of Wise men.

As you have confined your Appetites (in which Licentious persons are irregular) within due bounds, instituted by Nature, whereby they become proper instruments, as Incentives to supply our Necessities, and preserve Humane nature.

Your Lordship hath made good in a great degree the primary obligations of Nature in your Piety to your Maker by speaking Obedience to His most Sacred Commands, and in Justice to your Neighbor in the observance of the Law of Equality

DEDICATORY.

Equality, and in Sobriety in reference to your Person, in the prosecution of wholesome Rules preservative of it.

Your Life of Piety, Justice, Temperance, Charity and Devotion, are very Exemplary, as you are a Person of Honor and Fortune, and will allure others to conform to so excellent a Pattern, which if generally imitated, would conserve Humane Society, and prove a great Blessing to our Nation.

Your evenness and sweetness of Temper free from all extravagancy of Passion, do highly oblige all Persons that have the honor to converse with your Lordship. Your Generous and Hospitable disposition, (expressed in your Noble and Amicable Entertainments) do invite and treat your Friends with all Civility and Kindness.

I cannot but Congratulate your Lordship in your most Excellent and Accomplished Lady, a Meet-help for you, being as near akin to you in Vertue, as Person, and gives a most kind reception to all your Friends, which her Ladyship entertains with a pleasant Aspect, kind Language, and most endearing Civility, which renders your House a Paradise to all your Acquaintance, and Strangers, that have the happiness to converse in it.

I take the boldness to present your Lordship with this mean Paper (as a small Token of my most humble Duty and most affectionate Esteems) which I have affixed to the Chapter of Seeing, which I humbly beg your Lordship to peruse, as a most Noble Subject, Dedicated to
you,

The EPISTLE, &c.

you, who are so Candid as to pardon all Defects,
and so Favourable as to grant a Patronage to the
Studious Endeavors of

My LORD,

Your Lordships most Humble

and most Obligated Servant

SAMUEL COLLINS.

C H A P. VII.

Of Seeing.

HAVING Treated of the Rise, intermedial Steps and Periods of the motion of Light, as it is in several instances, and circumstances perfective of Sight; how innumerable minute Bodies stream out of greater Luminaries; and being mutually conjoynd, and not able to penetrate each other, the later still pressing forward, the former (*Sicut unda pellit undam*) are most swiftly carried with a direct progress through the several regions of the Hemisphere, till at last they attack the Atmosphere, and cause it to put off its dark Vail, and cloath it with bright Robes of Light; which arriving the Center, are beset with divers opace Bodies, whose Dense, and more compact substance, cannot entertain the beams of Light into its more inward Recesses; so that the Rays being dressed with several Lineaments and Figures of Bodies are forced to retreat. And now I will shew you how the Light newly modelled with various Shapes and Semblances of things (which *Aristotle* the Great Master of Philosophy, calleth visible Species; and the Atomists and later Philosophers, call Effluxes of Bodies) moveth in a Pyramide, whose Base or greater circumference is placed in the Surface of opace Bodies; and afterward its dimensions are more and more lessened, as its progress draweth nearer and nearer to the Eye, where it terminateth into a Cone at the *Cornea*.

The Surfaces of Bodies moulded into variety of Schemes and Figures, receive divers ornaments of Colours, after some manner derived from the unevennesses and Cavities, which are framed into Spherical, Elliptick, Conical, Cylindrical, and many other irregular Figures, according to the disposition of Opacé, and position of lucid Bodies, which sporting in a diaphanous Medium, are variously reflected from the Asperities and hollownesses of opacé Surfaces, in which the brighter beams of Light, receive an allay from darker Shades, which seem in some sort to constitute the greater variety of Colours, with which visible Objects are arrayed.

Our present Discourse is not of Mathematical Surfaces of Bodies, which being meerly imaginary, have no Dimension but that of Latitude: we now Treat of Physicall Surfaces, which though they seem, according to Sense, to be exactly Polite and Plane, yet in truth by help of a Microscope, we may easily discern most sensible Prominencies and Depressions, formed into various regular, and irregular Figures, in which the Rays of Light do play up and down; and as being foiled with various shadows, are productive of different Colours, wonderfully modelling visible Objects, which being represented to the Eye, give us a power to distinguish the different outward Faces of opacé Bodies.

The Rays of Light (arrayed with various Figures and Colours of things) may be compared to Lines (streaming out of the several points of visible Objects, intersecting each other in obtuse Angles, before they are received into the Pupil of the Eye, so that the visory Rays, reflected obliquely from any point of an opacé Body, do decussate each other about the *Cornea*, and that

Various images of things are arrayed with beams of Light.

Colours seem to be derived from Light, sporting upon the Protuberances, and Cavities of Bodies.

The visible Rays do decussate each other about the *Cornea*.

Ray is only to be excepted, which cometh perpendicularly in a right Line to the Axis of the Eye, without any Refraction.

An Experiment to make good the Victory Rays.

To illustrate this Hypothesis, I make bold to offer this Instance, If the Eye be shaded with a thin opake Plate, perforated with a small hole, through which the visible Object, seated beyond the Plate, may be transmitted, and recommended to the Pupil of the Eye by Rays, intersecting each other at the hole of the Plate, vailing the Eye; which may be confirmed by this Experiment; That if a thin little Plate (being placed between the Eye and greater Plate) be moved gradually toward the hole, the point of the visible Object may be discovered to be obscured, before the little Plate toucheth the hole on that side.

Because no point of a visible Object can be obscured by the interposition of some Body, unless the point of the Ray be intercepted; whence it followeth of necessity, that the Ray cometh from the point of the Object upon the little Plate, by reason the point is there first obscured, when the Plate is brought toward the hole of the other Plate, intercepting the Ray reflected from the Object in a direct progress.

The visible Rays must intersect each other, or meet, which is inconsistent with the nature of right Lines.

Wherefore if two Rays reflected from a visible Object, should not intersect each other near the Pupil of the Eye, they must mutually associate in their progress, which is inconsistent with the nature of right Lines, which must run parallel, or else right Lines must contain Angles, which contradicteth the received principles of Mathematicks; so that by consequence, the victory Rays must intersect each other, if they be supposed to take their course in right Lines.

The first propriety of the Experiment.

This Experiment may seem to be qualified with divers proprieties, (as Learned *Scheiner* hath observed) First, that the point of the visible Object is much shaded by the little Plate, and its situation disordered, the Right part being turned into the Left, and the Left into the Right, and the upper below, and the lower above, which is caused by the right progress of the Rays, whose intersection being intercepted by the interposition of the little Plate, the true situation of the Object is perverted.

The Second.

Secondly, if the hole of the Plate be made large, and the small Plate being interposed near the Eye on the Right side, the Left part of the hole will be obscured, and the Right remain open and free; but if the less Plate be moved beyond the greater, so that it cloudeth half or more of the hole, the Left Ray will be hid which happens, because the Ray reflected obliquely from the Right part of the visible Object, and transmitted to the Right side of the hole, doth make a greater Appulse on the Right side of the Eye, then that Ray, making its progress to the Left part of the hole, which deadens the activity of the Right Ray, from whence it may be evinced, that the intersection of the Rays of the Sight, give a clear perception on every part of the pupil of the Eye.

The Third propriety of the Instance.

Thirdly, a Ray proceeding from the Right side of the Object, doth fall upon the Left part of the Pupil of the Eye, and the Ray coming from the Left part of the Object, upon the Right region of the Pupil, and the upper part of the Object falling upon the lower, and the inferior upon the top of the Pupil of the Eye; whereupon the mutual intersection of the visible Rays do constitute the several parts of the Object in a due situation, which else would be represented to the Eye in great disorder, in an unnatural posture, confounding the Sight, as not receiving its Object, according to its true place.

But we need not any farther experiment fetched from Art, when Nature it self, the ground of Arts and Sciences giveth us an instance upon this supposition; That the Left side of the Pupil is clouded by a Suffusion, or a Membrane shading it; whereby the visible Ray cannot be freely transmitted from the Left part of the Object, which intercepteth the progress of the Left oblique Rays; so that it cannot meet the Right, and intersect it: Hence the visible images of things change their true situations, and the objects are presented to the Eye in undue positions, not suitable to the nature of things.

A Experiment
proving the
Intersection
of visible
Rays, fetch-
ed from Na-
ture.

By reason the point reflecting the visible Ray cannot be seen in a Right, but an oblique Line, as the object is blinded by a semi-circular opaque Body (seated in the Left part of the Pupil) hindring the point of the Ray, that it cannot fall upon the Left side of the Sight of the Eye, thereby nulling the intersection of the Rays, and perverting the due order of Sight.

This Experiment proveth the decussation of visible Rays, because in the disaffected Eye, if any object be presented to it in a direct Ray, falling about the Axis of the Eye, the visible Image is wholly obscured, and not at all capable to be discerned, by reason the obliqueness of the Incidence and Refraction; so that a part of the pupil of the Eye, covered with a dark Body, cannot see objects directly opposite, but seated on the other side; wherefore it may be determined, that the Rays streaming from the Object, as intersecting each other, are carried into the well-disposed pupil of the Eye.

Thus I having given an account how the lucid Rays (apparelling the semblances of outward Objects) intersect each other near the pupil of the Eye, that the faces of objects may be clearly presented to the Eye in right order, and due situation according to the nature of things

The Inter-
section of the
visible Rays,
produce the
preception of
the Object in
due order and
situation.

And now my aim is to shew you how Rays are trajected through various Mediums, as endued with divers degrees of Rarity and Density; whereupon Rays losing their direct progress (as they receive greater or less resistance from different Mediums through which they pass) do make greater or less Angles; so that the Rays are transmitted through the transparent Coats and Humors of the Eyes, differing in Situation, Figure, and Density, whereupon it follows of necessity, that the Rays must recede from their right progress, and suffer Refraction.

Wherefore seeing the various parts of the Eye have a different rarity and density, and most of their surfaces are excentrick, as relating to each other; Therefore the Rays passing the *Cornea*, must be refracted, so that the Sight must be made either in the Convex Surface of the *Cornea*, if it be celebrated by straight Rays, or else if the subject of vision be seated in the more inward recesses of the Eye (which I shall endeavour to prove hereafter) the Rays being carried through dissimilar Mediums, must admit refraction; whence it must reasonably be inferred, that Sight cannot be made by direct Rays with the Convex Surface of the *Cornea*.

Every lucid Ray (according to a natural Principle) doth move Hemispherically, and falling upon the *Cornea* of the Eye, doth irradiate the whole circumference of its Convex Surface, which receiveth a brisker appulse from a Ray moving in a right, then oblique Line; so that upon a supposition being made, that the act of Seeing is accomplished in the Surface of the *Cornea*; it must be granted, that a Ray coming from a visible point, and making its progress at right Angles, is the most strong, as over-powring others.

The right
Ray moveth
more strong-
ly then an ob-
lique.

By reason the Tunicle of the *Cornea* is outwardly prominent, as endued with an orbicular Figure, whence it is conspicuous, that a visible point (seated directly

The Rays represent every point of the visible Object.

directly opposite to the Pupil of the Eye) may fall upon it in a right line, which Ray is called *Orthogonos*; and being directly opposed at the *Cornea* to the Axis of the Eye, containeth the Third part, or almost half of a right Angle; so that the optick Cone, by which the Object is clearly discerned, is a right Angle, having its Vertex at the center of the *Cornea*; and the sides containing the Angle in a conick Surface, have their Base in the ambient parts of the visible Object; And by reason a distinct sight of its whole Base may be made at one glance without the motion of the Eye; it follows that all points of the Base do emit perpendicular Rays into the *Cornea*, and have the same power which the Axis of the Eye obtaineth; so that the Rays do represent every point of the visible Object; wherefore if the Convex Surface of the *Cornea* be the seat of Vision, that part of the thing seen, which maketh a right Angle in the center of the *Cornea*, must be distinctly discerned, which opposeth the received Principles of Experience, approved by Learned Mathematicians well versed in Opticks.

Having demonstrated how Vision cannot be ultimately celebrated, as falling in right Lines upon the *Cornea*, as it is a more dense Medium then the Air, and thereby giving a resistance to the visible Ray, causeth it to make an Angle of Incidence as well as Refraction, which are the subjects of my present Discourse.

A direct Ray.

A reflexe Ray.

A refracted Ray.

A Ray making a right progress from the Base of the visible Object, is Threefold; First Direct, when the Ray is carried into a transparent similar Medium, without any inflection: And Secondly, Reflexe, when the Ray falleth upon an opaque Body (not having Pores receptive of Light) is reverberated toward the Rays, coming from the several points of the thing seen. And Lastly, a refracted Ray is carried from one transparent Medium of a divers Consistence, as having different degrees of Rarity or Density; whereupon the lucid Ray being transmitted in a right line in the same similar Medium, maketh an Angle in the next Heterogeneous Body, at the point of Incidence, which is called the point of Refraction, as in it the Ray of Incidence first recedeth from its straight progress, and beginneth its Refraction, as forced to take an angular course.

A Ray called *Orthogonos*, maketh no reflection.

Every Ray that suffers a Refraction, in making an Angle, either cometh nearer the perpendicular, or recedeth more from it. By the perpendicular is meant a line erected at the surface of a diaphanous refringing Medium at the point of Incidence, and different from the perpendicular (called *Cathetus Incidentiae*) which is also named *Orthogonos*, as a lucid Ray runneth in a straight course, without the least inflection from one Medium to another.

But the other perpendicular being called that of Refraction, passeth through the sole point of Incidence: and the Surface making Refraction, is seated in the beginning, or upper part of the Surface, relating to the Heterogeneous transparent Medium.

The point of Incidence.

The point of Incidence is designed by the utmost term of the incident line, falling upon the refringent Surface of a diaphanous Medium, *viz.* The common point of the inward Surface, or termination of the former Medium, and the upper part, or Origen of the subsequent diaphanous Body.

The refraction toward the perpendicular. The incident Ray. The refracted Ray.

Wherefore when the lower Medium is endued with a greater Density then the upper, this kind of Refraction is made toward the perpendicular, as the Angle of Inflection, approacheth the Axis of the Eye; so that the Ray falling from the former Medium, is called Incident, as it relateth to the subsequent Medium, and as it belongeth to the former, is named Refracted; whence it happens, if there be many Lairs of transparent Mediums (through which

which some new visible point doth pass; all the intermedial Rays may be styled Incident; and refracted under a different respect to several transparent Mediums; and the last Ray is only refracted.

And the First lucid Line may have the appellation of Incident, and the last Refracted; and the intermedial line is named Incident, in reference to the subsequent Medium, and refracted in relation to the former.

Divers points have several Appellatives, and proper Offices; A Lucid point may truly assume the Title of Incidence and Refraction: But as it endeth in the surface of the last Medium, it cannot be called either the point of Incidence or Refraction, but of termination, and as a lucid point is trajected through the first Plane of the following Medium, it obtaineth the name of Incidence only; but the line passing down from the refringing surface of the former, through all the subsequent Mediums in a straight progress, is called the perpendicular. And because one right Incident upon another right Line, maketh either two right, or two oblique Angles; and the line of Incidence with the perpendicular, doth make two unequal Angles, of which the last is called that of Incidence, as the Angle coming from the incident Ray: And the least Angle derived from the refracted Ray, hath the Angle of refracted.

Every Ray streaming from the object to the Eye, and being trajected through the *Cornea*, and not stopped in its progress by the *Uvea*, doth insinuate it self through all the Coats and Humors, to the *Tunica Choroides*: For instance, Take an Eye out of the Head of any Animal, and you may discern rays of Light through the whole body of the Eye; or in a living Eye you may see its bottom, which is the *Choroides*. Wherefore if a Ray be obliquely transmitted to a surface of any diaphanous Coat or Humor of the Eye, it must necessarily admit a Refraction; but if the Ray be carried in a right Line, it passeth without any Refraction.

And the oblique Ray (refracted at the surface of any transparent Tunicle, or Humor of the Eye) proceedeth from the different degrees of their Rarity and Density, and Excentrick Situation.

And it may be truly affirmed, that the Ray passing from the point of a visible Object, through the Air into the *Cornea*, is refracted according to the perpendicular; because the Tunicle of the *Cornea* is endued with a greater Density than the Air.

But the visible Ray trajected through the *Cornea* into the watry Humor, is either not refracted at all, or maketh its Angle of Refraction from the perpendicular, as the watry Humor obtaineth a greater degree of Rarity than the *Cornea*.

And the lucid Line (flowing from a point of a visible object, and transmitted from the watry into the Cristalline Humor) is become refracted toward the perpendicular, as the Cristalline Humor is affected with more Density than the watry.

And if a Beam of Light, be trajected through the transparent Body of the Cristalline to the Concave Surface of the vitreous Humor, it suffreth a Refraction toward the perpendicular, as the vitreous Humor hath a less degree of Rarity than the Cristalline.

A Ray arising out of any point of a visible object, is carried by an Angular course through the Cristalline and vitreous Humor, and is brought into order by the *Retina*, by reason it is endued with a greater Density than any humor of the Eye; whereupon the Visory Ray is refracted toward the perpendicular, so that it is reduced to its true situation, in reference to the

The several causes of Refraction.

The Ray passing through the Air to the *Cornea*, is refracted according to the perpendicular.

The Ray passing from the *Cornea* to the watry Humor is refracted from the perpendicular.

The ray of Refraction at the Cristalline Humor.

The manner of Refraction at the vitreous Humor.

The manner of Refraction of the Ray at the *Retina*.

true perception of the visible Object in its proper place, which could not be effected if the *Retina* was endued with a greater degree of rarity.

The visible Rays are conceived to be Five

The rays of Light being emitted from any visible point, (till the object maketh an Appulse upon the *Retina*, the subject of Sight) are conceived to be Five in number; as the Rays receive various Refractions in the different Tunics and Humors of the Eye, qualified with several degrees of Rarity and Density.

The First Ray.

The Second Ray.

The Third Ray.

The Fourth Ray.

The Fifth Ray.

The First Ray is carried from the Object through the Air, in right lines to the *Cornea*. The Second is refracted by making Angles in the *Cornea*, toward the perpendicular. The Third visible Line (passing through the coat of the *Cornea*, is inflected in the watry Humor) recedeth from the Perpendicular. The Fourth lucid Ray being trajected through the watry Humor, suffereth a Refraction in the *Cristalline*, and maketh an Angle toward the Perpendicular: And the Fifth Ray is made in the *Retina*, as some will have it, in a right line, and others in an Angular.

All Rays, by whose mediation any visible point is transmitted into the Organ of Sight, are called *Visory*, of which some are less instrumental, secondary, and intermedial, and others principal and formal, as arayed with visible Images, making Appulses upon the immediate Organ of Vision.

And this propriety may be attributed to the extremity of a *Visory* Ray, that it is not formally an indivisible point, but endued with some sensible Dimensions, which may be proved by this argument; That seeing the Line (by which the Sight is acted) is not meerly Mathematical, as it hath breadth as well as length, and by Analogy the chief part of the Ray being the termination of the Line, must in some sort participate the same Dimensions with the rest of the Line.

The *Visory* Ray doth not terminate into a Mathematical, but Physical point.

Another Reason may be assigned, that the *Visory* Ray doth not terminate into an imaginary point, but a small Physical Body, else it is not any way capable to make a stroke upon the Fibrils of the optick Nerves, implanted into the Tunic of the *Retina*. Whereupon it cannot be discerned by the Organ of Sight, unless it be affected with Breadth and Length, which accompany all sensible Bodies, though never so minute.

The Line is properly and formally styled *Visory* (by which the Semblances of things are perceived) and is radicated in that part of the Eye, in which the act of Seeing is principally exerted, and other Tunics and Humors are subservient to it, as the ultimate and immediate instrument of Sight, clearly and distinctly discerning the object (after many Refractions have been made in different parts of the Eye) according to its true Figure, Colour and Situation.

The *Retina* is the immediate Organ of Sight.

Wherefore (I humbly conceive) it most agreeable to reason, that the chief part of the *Visory* Ray is seated in the *Retina*, in which the Ray doth terminate, and maketh the ultimate Appulse upon its most tender Surface, beset with numerous Fibrils (coming from the optick Nerve) and inserted into the *Retina*, as being an Expansion, made up of many nervous Plexes and Branches, by which the strokes of the *Visory* Rays are discerned in the Eye, and conveyed by the optick Nerves to the inward Sensory of the Brain.

The optick Fibres are not propagated through the Humors, to the other more remote Tunics of the Eye.

These fruitful Fibrils, lodged in the *Retina*, and derived from the optick Nerves, are not propagated through the Vitreous, *Cristalline*, and watry Humor into the other coats of the Eye, so that they cannot be sensible of the Appulses, made upon their Fibres (by the *Visory* Ray) which hold no intimate communion with the optick Nerves, as being not continued to them by the mediation of any Fibrils.

And

And it may be also proved, that the Ray, (coming from a visible point) is first refracted in the *Cornea*, and afterward is variously inflected in the watry, Cristalline, and Vitreous Humor, to and from the perpendicular, according to their different Rarity and Density; and the most significant part of the Ray is seated in the *Retina*, in which it terminates, and by it the object is reduced into a due order, by reason the Refractions of the visible Ray made in the several Coats and Humors of the Eye, as so many different Mediums, do distort it, which is regulated by the *Retina*, as it exceedeth the vitreous Humor in Density, whereby it bringeth the Ray to a perpendicular, and restoreth the said Ray to its proper situation, whereby the visible Object is perceived according to its true Figure and Colour, as they are found in nature.

And the excellent Fabrick of the Eye giveth a farther confirmation to this Hypothesis; that the most chief part of the Ray relating to Sight, may be truly attributed to the *Retina*; whereupon it happens, that a visible Object being diffused through the Hemisphere, should be contained at one view in the compass of so small a Pupil, and afterward be transmitted to the *Retina*, which is accomplished by various Refractions (made in several Membranes and Humors, as affected with a more or less rare substance) which are assisted by a due configuration of different parts, and their little situation in reference to each other, lest the more faint visible Rays, should be confounded by the more strong beams of Light, destructive of the Sense.

That the semblances of visible objects may be more clearly and distinctly perceived, the largeness of the vitreous Humor doth very much contribute, by whose assistance, the common concourse of refracted Rays are so regulated in the Cristalline Humor, that they may be more finely painted in the *Retina*.

How the vitreous Humor contributeth to Sight.

And moreover, the Figure of the Cristalline Humor, and its motion forward and backward, acted by the ciliary Processes, doth not only make the Cristalline Humor to be more or less distant from the vitreous Humor, but giveth a different configuration to the said Humor, and maketh somewhat of alteration in the Tunicle of the *Retina*; and the Cristalline Humor much conduceth to the variety of Refractions, and to the making of more or less strong Appulses of the visible Rays upon the *Retina*, and the more clear painting of the images of things upon the said Coat; which may be rendred evident in the small Sphaeres of Glass, resembling the Cristalline Humor of the Eye; so that if a Glass (like a Face in Figure) be placed near a small hole, (through which the visible Rays being transmitted from without to an opposite White Paper, put in an obscure place) not only the Situation and Figure of External objects, but their Colours too may be plainly discovered after such a manner, that no Artist can paint them with so much Life and Elegancy.

The various modelling of the Cristalline Humor, is made by the motion of the ciliary Processes.

If a Chamber can be rendred so close, that only a little or no entrance of Light may be admitted; and a small perforation being made, whose Diameter is the latitude of a Finger more or less (as it may be contrived by an Artist, according to the nature of the thing, and its proper use) so that the hole may give a reception to Light, and the visible Images of things (adorned with their lively colours) seated without the circumference of the hole, which may be tried by placing a White Paper at a due distance, which is rather discerned by Experience, then prescribed by Reason, and is ordinarily contained within two or three Spans of the hole, near which, if a Glass (endued with a Convex Surface) be placed, the Colours clothed with Light being

An Object transmitted through the hole of a wall, is lively painted on a Paper.

Glasses do
much contri-
bute to the
more plain
perception of
an Object.

being trajected through the transparent Compage of the Glass, may be clearly and distinctly discovered.

Glasses being the Segments of a greater Sphære, do require the Paper to be more distant from the hole, then those of a smaller Circle.

The Paper must be so placed about the hole, that the Ray transmitted through the Center of the Glass, may be rendred perpendicular, in reference as well to the Paper, as Glass.

If a Concave Glass be used without a Convex, it little or nothing contributeth to the discerning the visible Species painted in the Paper; but if the Concave be placed within the Convex-Glass, at such a distance as is requisite in an optick Tube, it will much advance the clear discovery of the Colours and Figure of the Object, to which it will add a greater Magnitude.

The Images of things are best seen in a Paper (seated near a hole in an obscure place) which disappear in a light room.

The First Hypothesis.

The first Hypothesis arising out of this Opinion, is, That every Ray streaming out of a visible point, is propagated in a direct line; so that the Object is everted, if the Rays do not suffer an Interfection, either before or behind the hole, which would not happen, if the Rays were not carried in right Lines, but refracted; whereupon, the Rays being intersected, the eversion of the Object will vanish.

The Second Hypothesis

Another Hypothesis may be this, That every point of a visible Object is emitted into the whole Hemisphære, with numerous Rays (which may be proved by this *Phainomenon*) else the Object will not pass through many holes into divers, or the same parts of the Paper.

The Third Hypothesis.

The Third may be thus deduced, That every Ray falling upon an Opaque Body, not receptive of it, as having too narrow Pores; whereupon the Ray is reverberated into every adjoining part of the transparent Medium; so that the Rays, reflected from one point of Incidence, do fill up the Hemisphære; which may be proved by this Experiment; Whether we see the Object reflected, or its Image terminated into the Paper, we must confess that Rays do stream from every point of the Image into the Hemisphære, by reason the Object may be discerned in every part of the adjacent Sphære, by Rays emitted from the same point, into the whole circumference of the *Cornea*.

The cause of the disorderly position of a visible Object.

And the Eversion or disorderly Position of the visible Images of things (rendring them Above Below, and the Right on the Left, and the Left on the Right Hand) doth happen, because the hole being small, doth exclude the transmission of the rest of the Rays.

When every visible point doth fill the Hemisphære with its diffusive Rays, it is manifest, that more are not capable to be transmitted, then the little compass of the hole can admit; so that the Object being much larger then the hole, it necessarily follows, either the Rays must be intersected, or else the Object make its progress in right Lines, or the Object must come upon the Paper in an everted Position; And by how much the farther the Paper is removed from the hole, the Object groweth more enlarged: and the greater hole doth represent the Object in larger Dimensions, if it be not too excessively large, and then the Object is not all, or very confusedly perceived, by reason too many Rays not intersecting each other, are transmitted through the hole, are because too much Light obscureth the Object.

And the reason why the visible Semblances of things (being transmitted through a hole, not over-much dilated) or everted, is, that the Rays, streaming from every visible point, run in right, and not in crooked lines, where

whereupon it happens, that the Rays passing through a hole, much less than the Object, cannot be transmitted by right lines, intersecting each other, so that the situation of the Object appears everted in the Paper, which is affected with the Ray carrying the Object, and its right Ray is discerned in the left part of the Paper, by reason the Rays are not intersected in the hole.

And the reason why a little thin Plate being placed between the Object and the hole in some near part opposite to it, doth obscure the whole Image in reference to the Paper, and rendreth it in a trembling posture, as much contracting it, which is caused, by reason the whole semblance of the Object is intersected in every point of the hole, in which a common Vertex of two Pyramids or Cones is placed, of which one is direct (whose Base or Termination is the radiant Surface of the Object) and the other Everted, in whose Base the Image is seated in the Image of the Paper: And when the Vertex of these Pyramids are intercepted by some opaque Body, the course of the everted Rays is put off, and the Image of the Object is not painted on the Paper; and if any part of the radiation, relating to the whole everted Pyramid, be eclipsed, the liveliness of the visible Semblance is darkened in the Paper.

The Image is obscured by a thin Plate.

If the little Plate be put within the hole, between the Paper and Convex-Glass, the image of the Object will be transferred to the opposite side, by reason the everted Pyramid, which runneth to one part of the Plate, and magnifieth the Image, is cut off, and that part, which hath its Ray transmitted to the other side, is conspicuous.

Wherefore in a Plate interposed, the Picture of the Object groweth more obscure in some, and more distinct in another; by reason the Plate doth lessen the hole, which by how much the more it is narrowed, it hath the fewer points of Intersections, and the fewer everted Pyramids, shining into one Base of the Paper; whence ariseth the obscuring of the Image relating to the Object; so that the eclipsed Pyramids, or Cones did not altogether confine on those that were not obscured, but now and then were transmitted farther, and sometimes deficient. Whereupon they obtained a mixture of diverse light and colour, which in some part made a confusion in the picture of the Object; so that some part of everted Pyramids, being intercepted by the narrowness of the hole; the other that were transmitted through it, had more distinct Rays, making more strong Appulses upon the Paper, and clearly imprint the Figure and Colour of some part of the Object upon it.

The great holes through which the Object passeth, render the Images in some sort more clear, and in others more confused. The less holes do make it partly more obscure, and partly more distinct, by reason every point of the visible Object doth diffuse it self (according to the capacity of the hole) upon the Surface of the Paper; so that if the hole be large, it filleth a great space of the Paper, because every visible point doth emit Rays hemispherically; whereby it darteth its radiated Pyramids (through an open hole) whose Vertex maketh the point; and the Hole the Base: or after the hole it is painted in the opposite Paper, or some other Plane, which is also made by any adjacent point, whence it ariseth, that the same part of the Paper doth receive the different Figures and Colours of divers points, which rendreth the Light more intense, and the colour and Picture of the Object more confused: But when the hole is so narrow that it is receptive of few points, then the irradiation of divers points of the Object, cannot be imprinted upon the same part of the Paper; neither can one point be divided confusedly into many;

A large hole rendreth the Image confused.

and fewer lucid Rays (not distracting each other, are transmitted to the Paper, whence cometh a more clear representation of the Object upon it.

The manner
how the
Image is ob-
scured by a
darkened
point of a
Convex-
Glas.

The whole image of a thing transmitted from any darkened point of a Convex-Glas into a Paper, is obscured without any change of its Quantity or Figure, by reason the species of the whole Object hath its Cone rendred more acute against every point of the Glas; in which it is also everted, and so far extended, till all its points are conjoynd with the Homogeneous Rays of any other everted Species; so that they agree with each other in some common Basis of the Paper: Whence it followeth that there are so many distinct everted Bases of the Image, placed over each other, and disposed after the same manner, as there are found divers points of Eversion and Intersection in the Convex-Glas, (which is not found in a hole free from it) and is caused by the refraction of Rays in a Convex-Glas.

A visible Ob-
ject emitteth
Rays in every
point.

This may be farther illustrated by this instance, That an Object emitteth Rays from all its points into a Convex-Glas, and maketh direct Pyramids at every point of it; but if the hole be naked, as divested of any Glas, the points will make their progress so directly, that the Angles of their Vertices may become equal on each side; so that everted Pyramids, can no where so concurr or meet, as all to obtain one common Base: But if any point be intercepted in a Convex-Glas, the whole Base of the Picture must be somewhat darkened; and if more points of the Glas be obscured, the common Base of the Image, belonging to the Object, will be more eclipsed; And the reason, (as I humbly conceive) may be this, That the whole Image of the Object doth emit Rays into one point of the Convex-Glas, after which, all Rays intersect each other, and make their progress in everted positions; so that one Ray follows another, and afterward passeth into one Ray, and the semblance of the whole Object is painted upon the Base in an everted posture; Hence it may be inferred, that the same Object agreeth in a point of a Convex-Glas, and afterward parteth in an everted course, according to the Pyramid made in the Base, which is intercepted in a point of an opake Body; so that a line drawn from a common Base, doth intersect an everted Pyramid, after the same manner placed upon the Base of the Pyramid, because the Rays coming from the point of a Vertex, are transmitted to a point of the Convex-Surface of the Glas, and are like as equal both in respect to their length and refraction, and do intend each other by a mutual super-imposition.

Hence it may be made evident by Reason and Experience, that every visible point doth emit a radious Cone to the surface of all the Glas; the Base of which Cone is placed in the ambient part of the Glas, and the Vertex of the Ray in the visible point, and the whole Pyramid is refracted in the Glas, and all the Rays being trajected the Glas, have an inclination and tendency to each other, till they seem according to sense to agree, and as it were concenter in one point.

Many Rays
may be re-
fracted into
one point,
as they are
united in a
point of a
Convex-
Glas.

If a visible point emit a Cone, in whose conick Surface many intermedial Rays do shine through the whole surface of the Glas (whether it be Plane or Convex) they are all refracted into one point; whence it cometh, that the visible point is so clearly and lively represented by the conjunction of many Rays in a Cone; hence the lenticular Convex-parts of very little Sphares, represent very small Images of visible Objects after a clear manner, by reason many visible species are united in one point, and the Pyramids are rendred more acute, then they are in the segments of greater Sphares; as also because the Bases are rendred more near to the Glas, and so are endued with more

strong

strong Rays, and from hence it is, that if one point of the Glass be obscured, and its Ray eclipsed, yet notwithstanding the visible point may be discerned by other Rays, by reason the whole Object is transmitted by a right progress of the Rays into every point of the Glass; and from this afterward, a Refraction and everted position is made of united Rays, painting the Object upon the opposite Paper, as a Base common to the everted Cones, and Pyramids.

The former Discourses of experimental Opticks, drawn from Art, hold great correspondence with things of nature, and do much contribute to the better understanding of the manner of Sight, as natural operations are illustrated by artificial instances; so that the many said Hypotheses, and Experiments are fitly applicable to the parts and Sight of the Eye.

Natural Operations are cleared up by artificial Instances.

The hole made through a Wall into a dark Chamber, somewhat resembles the Pupil (leading into the more inward recesses of the Eye) as it is receptive of Images, streaming from a visible Object; and the Rays coming in direct lines intersect each other, before they enter the perforation of the Wall, as well as the lucid beams admit a decussation, before they are received into the Pupil; and the progress of the Rays is made in a Pyramidal Figure, as they are endued with a Cone, where they are transmitted through the *Foramen* of the Wall; after the same manner the visible Rays are more enlarged toward the Object, from whence they are reflected, and afterward are lessened into a Cone, where they are immitted into the hole of the *Uvea*.

A Hole made through a Wall, in some sort is like the Pupil of the Eye.

If the hole of the Wall be too large, the Object is confusedly painted upon the Paper, by reason the beams of light being too bright, do obscure the Colour and Figure of the Image, which happens in like manner in nature, wherein the Species is clothed with over-lucid Rays, transmitted through too open a Pupil; whereupon the visible semblances are eclipsed, as the dark chamber of the Eye are rendered too bright, so that the Sight is confounded by over-much Light.

Too large a hole render the Images of things obscure.

The Paper placed at a due distance from the hole of the Wall, receiveth the shape and colour of an Object, passing through the *Foramen* of the Wall.

The Paper placed at a due distance from the Eye, resembleth the *Retina*.

The *Retina* is not unlike the said Paper, as the Image being emitted from any point of an Object, is carried through the Pupil of the Eye, and at last imprinted on the *Retina*.

Every point of a Convex-Glass (covering the hole of the Wall) receiveth the Cone of the Object, whereby it is more clearly seen, and as the Rays grow more united in the Surface of a Convex-Glass, they are trajected and carried to the surface of the Paper, where the Colour and Figure of the Object may be more clearly discerned.

The Crystalline Humor of the Eye hath some likeness with a Convex-Glass, as it is transparent and endued with a parabolical Figure, in which the visible Rays arrayed with Light, are more contracted, whereby the Image of the Object is painted more lively upon the *Retina*: And also an intersection of the Rays is made, as well in Crystalline Humor (seated not far from the Pupil of the Eye) as in the Convex-Glass placed near the hole of the Wall.

A hole open and uncovered, giveth a faint representation of an Object; but the addition of a Convex-Glass rendreth the Image more clear and distinct upon the surface of the Paper; after the same manner (I conceive) it would be in the Eye, if the Crystalline Humor had been deficient, whereby the semblance of the Object, being appparallel'd with Rays of Light, and transmitted

A hole without a Glass, giveth an obscure resemblance of an Object.

mitted through the perforation of the *Uvea*, would make but an obscure and weak impression upon the *Retina*; but the application of the *Cristalline Humor*, near the Pupil of the Eye, makes the species more clearly painted upon the Organ of Sight.

The motion of
the visible
Rays is Pyra-
midal.

The lucid Rays moving in pyramidal Figures, First directly toward the hole of the Wall, and afterward beyond it, make their progress in everted Pyramids having greater Dimensions toward the Paper.

In the same form the Rays (darted from every point of a visible Object in right lines) are contracted with a Cone in the Pupil of the Eye, and beyond it have another everted Cone, which afterward are enlarged toward the *Cristalline Humor* and *Tunicle* of the *Retina*.

Art is perfective of Nature, which may be illustrated by the reflected and refracted beams of Light (investing a visible species, passing through a narrow hole, somewhat resembling the Pupil of the Eye) into a more open place, and grow more faint, as they obtain a greater freedom by parting from each other, and afterward become more strong, as they are narrowed into a point in a *Convex-Glass*, whereby the Object is more clearly painted upon the adjoining Paper in its hue and lineaments.

The Rays are
interfected
before they
enter into the
Pupil of the
Eye.

This Instance hath much Analogy with the visual Rays, which are mutually decussated, before they are entertained into the Pupil of the Eye, and are afterward transmitted to the *Cristalline Humor*, endued with a *Convex* form, that the intromitted Rays being united and refracted, might be brought into order, and rendred more vivid, and regular, making the semblance of the visible Object more plainly and distinctly imprinted upon the filme of the *Retina*.

The disorder-
ly situation of
the Object
maketh it
confused.

The Paper being placed too near, or too remote from the hole without the common Base of the Rays (conveyed to the hole) render the Image more confused and obscure: so after some sort when the Rays being transmitted through the Pupil of the Eye, have not a common concurrence or Base duly terminating into the *Retina*; whereupon the visible semblance of a thing is not clearly perceived, as the *Retina* is seated, either too near, or at too great a distance from the *Cristalline Humor*, and Pupil of the Eye: And as the Paper is placed at too little or too great a space from the *Convex-Glass*, and hole of the Wall; whereupon the visible species is confusedly painted upon the Paper, which is amended when the common Base, (investing the Picture) is orderly transmitted to the Paper, by the due situation of it, in reference to the *Convex-Glass* and Hole; so a great change is made of the representation of the visible Object to the Eye by the variation of the place of the *Retina*, and *Cristalline Humor*, in relation to the Pupil; so that the due situation of the said *Tunicle* and *Humor*, doth render the portraiture of the Object to be fairly painted upon the fine Coat of the *Retina*, as the common Base of the visual Rays do terminate upon it.

The reason of
the motive
power of the
Uvea and cili-
ary Processes.

And upon this account, Nature hath conferred a motive power, both upon the *Tunicle* of the *Uvea*, and the *Ciliary Processes*, elevating and Contracting the *Cristalline Humor*, and when the too great concurrence of the lucid Rays (clothing the visible Object) is intercepted, the *Cristalline Humor* is compressed, and made more *Convex*; or more *Plane*, by the relaxation of the *ciliary Processes*; Whereupon the Rays (investing the visible Images) become more or less refracted, as the Figure of the *Cristalline Humor* is made more or less prominent; and as the *Retina* is brought farther from, or nearer to the said *Humor*, and to the Pupil of the Eye; that the *Retina* may receive the common Base of the Image: Whence it cometh that the Eye is discomposed with

with pain, when the Object is placed too near the Eye, which is produced by its labour, when the visive power endeavours to compose and frame the Tunicles and Humors, which cannot be accomplished without compression, giving a pain and disturbance to the tender and fine Compage of the Eye.

To give a more clear understanding of the notion of Sight, I shall endeavour to make Art to run parallel with Nature, how Convex-Glasses do assist and rectify the ill formation or Constitution of the Cristalline Humor; and how one Convex-Glass being added to another, doth render the common Base of the visible Image more near to the Glasses: So in like manner the Cristalline Humor hath lost much of its parabolical Figure, as brought toward a Plane, being shrunk up in old Men; whereby the common Base of a visible Object is carried too much inward beyond the Tunicle of the *Retina*; so that to help the ill shape of the Cristalline Humor, old Men are constrained to use Spectacles, endued with a prominent Surface, that by a double Convexity, relating to the Glass, and Cristalline Humor, the Base of the Picture, belonging to the Object might be contracted, and duely imprinted on the *Retina*.

Convex-Glasses do supply the defect of the Cristalline Humor.

And as a Concave-Glass to a Convex, doth cause the Rays carrying the Image of the thing, to pass farther to the bottom of the Eye, which giveth an advantage to persons, labouring with an over-much parabolical Figure of the Cristalline Humor, determining the common Base of the semblance of a thing upon the vitreous Humor, productive of a confused Sight; as the visual Rays do not reach the *Retina*, which is much helped by Spectacles (endued with a Concave-Surface) transmitting the species of the Object, beyond the vitreous Humor, unto the coat of the *Retina*, the formal Organ of Sight.

Having given in some sort a History of Opticks, I shall endeavour to speak a period to this Discourse, in shewing a short model of Seeing; as Light acteth a great part in this visible Scene, and may be stiled a Body made up of innumerable lucid Particles, originally streaming from every point, and carried into the minute pores of the *Æther*, and Air, with most nimble Motion, as the most numerous Rays press each other forward with an inexpressible swiftness, till they meet with some opake Body, which being compact (as consisting of small Pores) is not receptive of lucid Rays; whereupon they being embodied with Images, as so many Effluxes of opake Bodies, make first a kind of Arch, and afterward are reflected in right lines through a fluid Medium, beset with numerous steams of a different Consistence.

A short model of Sight.

The Light being displayed through various Bodies, retaineth the posture and Situation of their parts, and produceth several Schemes, according to the different Figure, and Texture of those parts of which they are compounded; so that the lucid Beams falling upon opake Bodies, do by quickness of Motion, Energy, and several Reflections, cause variety of Apparencies, according to the different degrees of Rarity and Density of several Mediums, affected with strong and fainter Rays; or according to several Asperities of dark Bodies, made up of greater or less Cavities, do produce divers Lights and Shades, the ground of various Colours, and Semblances of visible Objects, which being clothed with Rays of Light, are reverberated from opake Bodies, in a direct progress through the Air, to every point of the *Cornea*, where they are refracted, by making an Angle toward the perpendicular, as passing from a rare to a more dense Medium, and having intersected each other, as the Right Rays are carried to the Left, and the Left to the Right, else they

Variety of Apparencies proceed from different dispositions of diaphanous Mediums. Different Colours may be fetched from several Lights and Shades, caused by divers Prominencies and Cavities of Bodies.

The Rays after Interfection are contracted into a Cone in the Pupil of the Eye.

The Rays are rendred strong, as united in the parabolical Figure of the Cristalline Humor.

The Image of the Object is brought to a due Situation, when imprinted upon the *Retina*.

could not move in direct lines; and after Interfection, the Rays are contracted into a Cone, and received into the Pupil of the Eye, and there make their progress in an everted Pyramid, as beginning in a Cone, and make another Angle, by being refracted in the watry Humor from the perpendicular, as proceeding of a more Dense into a more rare Medium: And after the visual Rays, being trajected through the watry Humor, they are transmitted to the Cristalline, and narrowed into a point of Refraction, and make Angles toward the perpendicular, and are rendred more strong as they are united, which is effected by the globular Figure of the Cristalline Humor, as being rendred more parabolical by the motion of the ciliary Processes, compressing the said Humor, and making it more protuberant; whereby the Rays of Sight do grow more Refracted; and being transmitted from the Cristalline Humor to the Vitreous, make a different Angle, and are inflected from the perpendicular, as being brought from the more dense Medium of the Cristalline Humor, to the more rare substance of the Vitreous Humor, from whence the lucid Rays (investing the Images of things) are transmitted to the *Retina* as a more-dense Medium, in which the Rays are refracted toward the perpendicular, and thereby, their situation is amended, and reduced to a due posture; and their common Base regularly imprinted on the *Retina*, wherein the Figure and Colour of the visible Object are clearly and lively painted, and most plainly discerned by the outward Organ, and from thence recommended by the continuation of the optick Nerves to the inward sensory, judging and determining the nature of outward visible Objects.

CHAP.

C H A P. VIII.

The Diseases of the Eye-lids, and their Cures.

THe Eyes are two lucid Globes, composed of many Sphares, of divers membranous circular expansions, curiously lodged within each other, and enclosing variety of Humors; all which are rendred transparent (except one perforated Membrane) as receptive of several Images of things, apperall'd with Light, to treat us with divers pleasant prospects.

The Eyes being systems of various substances (finely enwrapping each other) as Glands, Muscles, Membranes and Humors, outwardly encircled with Lids, as with Curtains, have as many Diseases as Parts, of which I will discourse in the order Nature hath instituted.

The Lids first presenting themselves, as enclosing the Eyes, are obnoxious to divers disaffections, the first is called by the *Greeks*, *τέχχωμα*, which is affected with divers degrees; one is, when the Eye-lids are inverted, they appear more thick and unequal, named by *Aetius*, *Δασύτης*, *densitas palpebrarum*, in which the Lids are inwardly red, as coated with stagnated Blood.

The Redness
and Thickness
of the Eye-
lids.

The second degree of a *τέχχωμα*, is, when the Disease growing higher in the inward region of the Lids, is discomposed with little Tumors resembling the Seeds of unripe Figs, from whence it received the appellative of *σύνκωσις*, by the *Latines*, *palpebra ficosa*.

The Tumors
of the Eye-
lids.

The third degree is named *πύλωσις* by the *Greeks*, and *Callositas* by the *Latines*, when the inside of the Lid is first Ulcered and afterward groweth hard and Callous.

At last as a fourth degree may be named *ψευδοθαλμία*, *scabies palpebrae*, in which not only the inside of the Eye is disaffected, as in a *τέχχωμα*, but the whole Lid is rendred rough and scabby, chiefly about the angles of the Eyes.

The Scabs of
the Eye-lids.

The cause of these disaffections proceed, sometimes from serous salt Humors, other times with Bilious Recrements mixed with the mass of Blood, and imported into the substance of the Eye-lids by the terminations of the external Carotide Arteries.

The cause of
the Diseases
of the Eye-
lids.

The Cure of these Diseases is performed by Bleeding, and proper Purgatives, and then Topicks may be safely applied, as emollient Fomentations which do temper the Acrimony of the Humors, and afterward detergent and drying Medicines, prepared with Water of Pimpinell, Salendine the Great, Small-leaved Dock, mixed with Burnt Aloë, Camphore, and Crabs Eyes, which being boiled and strained, the Water may be applied to the Lids. A Liniment made of ointment of Roses, and Tutty hath been used in these cases with good success.

Other Tumors are also incident to the Eye-lids, as Warts, *Hordeola*, resembling Barley-corns, Grandines, round transparent Swellings, and divers Nodes and Excrescencies, sometimes of a Stony nature, which are cured by Emollient Decoctions and Liniments, and if they cannot discharge the con-creted Matter, Chyrurgical Operations may be advised, to take away these indurated Swellings by Section.

Divers kinds
of Swellings
belonging to
the Eye-lids.

C H A P. IX.

The Diseases of the Glands of the Eyes, and their Cures.

The Diseases
of the Glands
of the Eyes.

An Inflamma-
tion of the
Glands.

THE Glands of the Eyes are subject to divers Diseases, Inflammations, Ulcers, Fistulas, Diminution, and too great Dimensions.

An Inflammation of the Glands relating to the Eyes, proceedeth from a quantity or grossness of Blood imported by the Carotide Arteries into the substance of the Glands, so that the extremities of the Jugular Veins are not capable to receive all the Blood, whereupon some part of it being stagnated, loseth its tone, and the Serous Particles are turned into a Pus, which breaking through the body of the Glands, is discharged upon the Surface of the Eye.

The Ulcer of
the Glands.

If the Ulcer groweth inveterate, the passage through which it dischargeth the Purulent Matter, will be rendred Callous and Sinuous, whence ariseth a *Fistula Lachrymalis*, which is not only a consequent of an Inflammation and Ulcer, but is generated immediately by acrimonious and ferrous salt recrements of the Blood, productive first of an Ulcer, and afterward degenerates into a *Fistula*, which also is caused by a gross clammy Humor, resembling a Pultice, or Honey, and called *Atheroma steatoma* and *Meliceris*.

The Cures of
the Diseases of
the Glands of
the Eye.

In order to the Cure of this Disease in its first rise of an Inflammation, a Clyster being premised, Bleeding is to be celebrated with a free hand; In reference to an Ulcer and *Fistula*, cleansing, drying, and consolidating Medicines are to be used, made of *Sarzaparilla*, *Lignum sanctum*, *Sassafras*, Comfrey Roots, Mouse-Ear, Sanicle, Ladies Mantle, &c. boiled in Water, and sweetned with Honey.

Outwardly Medicines may be applied made of Powder of Frankincence, Sarcocoll, *Aloes*, Dragons Blood, *Balanstia*, Alome prepared, and mixed with Rue Water.

A *Setum* in the Neck proveth very beneficial in a *Fistula*, as diverting the offensive Matter from the Eyes.

If an Ulcer and *Fistula* proceed from a Venenate Matter in Venereal Diseases, Purgatives may be advised, mixed with *Calamelanos*, and proper Diet Drinks may be used in Venereal Distempers.

I have seen a gentle Salivation raised by Mercurial Medicines, to be attended with great success in order to the Cure of an inveterate Ulcer and *Fistula*.

The Absump-
tion of the
Glands.

Rhyas frequently accompanieth a *Fistula Lachrymalis*, and is an absumption of the Gland, seated in the inward angle of the Eye, proceeding from sharp Corrosive Humors mixed with the Blood, and brought into the body of the Gland (by the Carotide Artery) which being of a loose spongy substance, is easily Corroded by acrimonious and salt Recrements.

The Cure of
a *Rhyas*.

This Disease is Cured by Detergent, Drying Sarcotick, and Astringent Medicines made of Flowers of red Roses, Cypress Nut, Myrtle, *Aloes*, boiled in Water and Red Wine, or also with Ingredients of Frankincense,

kinckense, Aloes, Dragons Blood, Red Rose Leaves, Grains of Sumach, boiled in red Rose Water and strained.

The over-great excrescence of the Gland is lodged in the inward angle of the Eye, which is generated by a quantity of *Succus Nutricius* (as being much akin to Seminal Matter) stagnant in the body of the Glands, and enlarging their dimensions, as agglutinated to the outsides of the Vessels.

This Disease is Cured by gentle Corrosive Medicines of Burnt Alome, &c. and great care must be had in the application of Corrosives, lest the tender compage of the neighbouring Eye be highly offended.

Another disaffection of the Glands of the Eyes (sometimes accompanying the *Rhyas* and *Encanthis*) is called *Epiphora*; The word denoteth any fluxion of Humor, but the Professors of our Art have confined it to the Afflux of Humors, coming from the Gland placed in the greater angle of the Eye, and may proceed also from the Glands of the Eye-lids, secreting and pouring out thin recrements of the Blood by excretory Vessels upon the surface of the Eyes. These involuntary Tears, are cured by Bleeding, Purging, drying and astringent Medicines; and Fontanels and Blistering Plasters, are of great use in order to the Cure of this Disease.

Sometime tears of Blood do issue out of the angles of the Eye, by the terminations of the Carotide Arteries, which is derived from the suppression of the *Menstrua*, and is cured by Purging and Aperient alterative Medicines opening the Vessels of the *Uterus*, and provoking the *Menstrua*, which is much assisted by opening the *Saphena instanti tempore fluxus menstruorum*.

C H A P. X.

The Diseases of the Muscles of the Eyes.

THe Muscles of the Eyes being the Machines of Motion, by which they are lifted up and depressed, as also turned inward and outward, and are acted with various positions, for the better discerning Objects, seated above, below or on each side of the Eyes.

The resolution
of the
Muscles of the
Eye, and its
Cure.

The chief diseases that attend the Muscles of the Eyes, are a Palsie and Convulsive Motions. The first produceth a resolution of some or more Muscles of the Eyes, which proceed from the defect, or the course of the Animal Spirits intercepted, so that they cannot flow into the motory Nerves of the Eyes, which should concur to the actuating their Fleishy Fibres, the fine engines of Motion.

This Disease is cured by proper Cephalick Purgings and alterative Medicines that open and corroborate the Motory Nerves of the Eyes; in order to it I refer the *Courteous Reader* to the Cure of a Palsie in general.

The Convul-
sion of the
Muscles of the
Eye.

The Convulsion, relating to the Muscles of the Eyes, (called by the *Latines*, *Strabismus*) when the Pupil of the Eye is not directly opposed to the visible Object, when the due situation of the Eye is perverted, by the Convulsion, or Convulsive motion of the Muscles, belonging to the Eyes, wherein they are involuntarily lifted up or drawn downward, or pulled inward or outward; whereby the natural position of the Eye is distorted, and the Pupil too much inclineth to the Nose when the Adductors are disaffected, and to the Temples, when the Abductors are discomposed, and upward when the Elevators are irritated, and downward when the Depressors of the Eyes are disturbed by Convulsive Motions, which are derived from sharp or salt Recrements affecting the Nervous Liquor, having recourse to the Motory Nerves of the Eyes, which being irritated, do produce Convulsive Motions in their Muscles.

The Cure of
the Palsy re-
lating to the
Muscles of the
Eye.

In this case Bleeding is very proper in a Plethorick Body, which immediately relieveth the Patient, gentle Purgatives mixed with Cephalicks, and proper Alteratives to corroborate the Nerves, are often crowned with good success, to which may be added Blistering Plaisters, which oftentimes speak ease to the Patient; as I have experimented in Children (with good success) labouring with frequent Convulsive Motions of the Muscles, distorting the Eyes.

The trem-
bling motion
of the Muscles
of the Eye.

Another Disease, affective of the Muscles of the Eyes, is named *τρεμσις*, by the *Greeks*, wherein the small and weak Muscles, are acted with trembling motions, as unable to keep the Eyes in a firm fixed posture, by reason the weak antagonist Muscles are not able to balance each others contractions in a due tonick motion; whereupon the Eye is agitated with frequent, quick Vibrations, called vulgarly *Twinklings* in the Eyes.

Diseases so-
luta unitatis
belonging to
the said Mus-
cles.

Diseases also *Soluta unitatis*, do afflict the Muscles of the Eyes, as wounds, blows, deep punctures, by which the Eyes are cut and torn, and rendred unfit for sight; of which Learned *Sennertus* giveth an instance. *Vir quidam Nobilis, ut ad me perscripsit D. Dr. Jacobus Janus. Sereniss. Elect. Viduae Licktenburgi Medicus, Equi insidens caput ligno acuminato ita allisit, ut ligni portio*

portio ad interiora Oculi penetrans Musculum Oculi sinistrum attollentem rumperet. Hic Convalescens, Oculum quidem habet saluum, sed omnia geminata videt. Cuius rei causa est, quod cum Musculus Oculum recte regere nequeat, species visibiles in diverso plano statuuntur, & sic retina tunica difformiter pingitur, & dupliciter objectum percipitur.

CHAP. XI.

Of the Diseases of the Adnata.

THe *Adnata* being a Tunicle, or expansion of the *Pericranium*, making the White of the Eye liable to many Diseases, among which an Inflammation (called by the *Greeks*, *ὀφθαλμία*, is the most eminent, and is derived from a quantity of Blood discharged by the terminations of the Carotide Arteries into the Interstices of the Vessels, lodged in the *Adnata*; This Disease is accompanied with a great redness, heat, tears, and pain, as the Eye is a fine Contexture, made up of many minute nervous Fibrils, giving an acute sense to the *Adnata*, as well as to other Tunicles of the Eye.

The Inflammation of the *Adnata*.

This troublesome Disaffection admitteth degrees more or less discomposing the Eye. The first is called *πύρεξις*, *Perturbatio*, being a gentle Inflammation, flowing from the heat of the Sun, Smoak, Dust, and intemperate drinking of Wine.

The first kind of Inflammation called *πύρεξις*.

In a great inflammation of the Eyes, the Blood is carried in a larger proportion into the substance of the *Adnata* by the Carotide Arteries; So that the origins of the Jugular Veins cannot readily receive it; and if the inflammation be so far aggravated, as that the Eye-lid are inverted, then the Eye groweth very red, having as it were a gap in it, caused by the Black of the Eye subsiding, and a great redness shading its White, produced by the fullness of the Blood-vessels highly painting the *Adnata*.

This degree of Inflammation hath the appellative of *χμωσις*, and *τὴν χμωσιν*, *ab Hiatu*; And hath four degrees; In the beginning the Matter of the Disease is thin; and the Eyes have the *Adnata* coated with a blush of Red; in the increase of the Disease, the Eyes are afflicted with a greater pain and hued with a deeper redness; in the state the signs of Concoction appear, and the Humors are more incrassated, by which they are closed up after sleep; and lastly in the declination the redness, pain, and involuntary tears are lessened.

The second kind of Inflammation of the Eye, called *χμωσις*.

In order to the Cure of an Inflammation, first all endeavors are to be improved in the hindering the flux of Humors into the Eye, both by revulsion, derivation, and by gentle repelling and resolving Medicines.

The Cure of an Inflammation of the Eye.

The second Indication in an Inflammation, is to apply Anodynes to free the Eye from heat and pain (as being a part of most acute sensation) with most temperate and soft Medicines.

I humbly advise the opening of a Vein, and Blood freely to be taken away in an *Ophthalmia* (a Clyster being premised) which oftentimes effecteth a great part of the Cure in the beginning of this Disease; and in Plethorick Bodies, a Vein may be opened in the Neck and Arm divers times, which

which I have seen perform'd with good success. A temporal Artery may be also opened without the least danger (when the inflammation of the Eye is attended with intolerable pain of the Head) which I have advised with great advantage to my Patients in extremity.

Gentle Purgatives may be safely advised, mixed with Eye-bright, Salendine the Great, Vervain, &c. and afterward Cupping-glasses may be applied to the Back, Shoulders, and Neck; and Blistering Plaisters between the Shoulders, and to the Neck, and under the Ears, have proved very beneficial in this case.

Inward Medicines made of Cooling Ingredients, and temperate Specifics, may be safely administered.

After Bleeding and Purging, Topicks may be used, in which a care must be had, that repelling Medicines be not applied to the disaffected parts, which do incrassate the thin Humors, and so detaining them, do increase the pain and inflammation.

Astringents made of *Bole-Armenick*, Dragons Blood, Mastick, and Red Roses, may be mixed with the White of an Egg, and Red Rose Vineger, and applied to the Forehead, by which the Humor flowing toward the Eyes, may be repelled.

Among Anodynes in violent pains, accompanying the inflammation of the Eyes, Milk, especially that of a Woman, may be injected gently into the aggrieved part.

The White of an Egg beaten into a thin watry Liquor, is highly commended by great *Galen*, as alleviating pain, and gently checking the flux of Humors.

The Pulp of a roasted Apple is a good Anodyne in this case, and Mucilages of the Seeds of *Psyllium* and Quinces extracted in Rose Water, which must be often renewed, lest being long made they contract a foureness, and discompose the inflamed Eyes.

In the beginning of the Disease a Cataplasim may be made of the Pulp of a roasted Apple, of the Seeds of *Psyllium* and Quinces extracted in Rose Water, and with a little of the White of an Egg, beaten into Water, and of Womans Milk, and being mixed, may be applied to the Eyes.

The White of an Egg (being beaten up with a little Alome in a Leaden Dish, to the consistence of an Ointment) may prove very advantageous in this case, if it be applied to the Eye but an hour or thereabouts, and then removed, lest by its long stay it should overmuch thicken the Humors in the Eyes, and heighten the Disease.

In the increase of the Disease gentle Discutients may be mingled with repelling Medicines, as distilled Water of Eye-bright, Fennel, Salendine the Great, mixed with the Mucilages of Line-seed extracted in Rose Water, to which may be added upon occasion, the *Trochisci Albi Rasii sine opio*, and Prepared Tutty; and Sarcocol nourished with Milk, when the Disease cometh toward a hight: This last Ingredient must be often macerated in Milk, and several times changed, else it groweth soure and spoileth the vertue of the Medicine.

Quercetan in his *Pharmacopeia*, giveth a great Character of *Crocus Metal-lorum* infused in Eye-bright or Fennel Water, which is powerful in this case, and doth not discompose the Eye with any sharpness.

A Water may be prepared with Calcined Lead, or Lytharge, and with Minion Red Lead, infused in White Wine Vineger, which being applied to the Eye, doth work a great Cure in a short time, as Learned *Rivier* will have it.

In

In the state of the Disease the resolving Medicines should overpower the repelling: Fomentions made of Flowers of Chamæmel, Melilote, and Red Roses, Fannygrick-seed boiled in water and strained (to which may be added a little white Wine) may be serviceable to the Eyes.

Renowned Riviere giveth a great Encomium of Oyl or Liquor (made up of burnt Linnen, set on fire and quenched between two Pewter Dishes) of which a drop mixed with a Childs Spittle, may be put into the Eye with a Feather.

In the declination of the Disease water mixed with Red wine, proveth very useful, as also a Medicine made of Aloes, Prepared Tutty, Sugar-Candy, infused in Rose water and white Wine, and exposed to the Sun for 40 days, of which a few drops may be instilled into the Eye.

The *Adnata* is incident to another Disease called by the *Latines*, *Unguis Oculi*, and by the *Greeks*, *πτερυγιον*, from the resemblance it hath with a Man's Nail, or the wing of a small Bird; and sometimes it is like the tricuspidal head of an Arrow; so that it sometimes received the appellation of an Arrow.

It is described by *Celsus* and other Physicians, to be a fibrous or nervous Membrane, arising from the greater or inner Angle of the Eye, and rarely from the less or outward; This Excrescence is often the product of an inveterate Ophthalmy, or proceedeth from the little Pustles or Small Pox, or from some stroke or contusion of the Eye, or from excrementitious Humors or ferous parts of the Blood (destilling out of the terminations of the Carotide Arteries inserted into the surface of the white of the Eye) which are con- creted into a thin membranous substance (affixed to the *Adnata*) and is en- dued with several Figures, whereupon it obtaineth variety of denomi- nations.

Gentle purging Medicines, mixed with Specificks, are very good and are often to be repeated; Blistering Plaisters, and a *Setum* in the Neck, often prove very useful in this case.

In reference to this ail, as an Excrescence, Detergent and Corrosive Me- dicines are beneficial, made of Sugar-Candy, infused in Eye-bright or Fen- nel water, to which may be added a little Nitre, or white Vitriol, or burnt Harts-Horn; Egg-shells steeped in White Wine Vineger, and afterward be- ing dried and finely powdered, may be applied to the Eyes, as also Alome, Ceruss, or Camphor infused in Eye-water, may be used to take away this Excrescence.

A Disease near akin to a *πτερυγιον*, is called by the *Latines*, *Pannus*, a Tu- nicle or Excrescence resembling fine Cloth, or a Contexture covering the *Adnata* and sometimes the *Cornea*, made up of many Vessels filled with stag- nated Blood, which being discharged through the terminations of the Ar- teries, is lodged sometimes between the Vessels of the *Adnata*, and seemeth to be like a kind of Cloth-work, which proceedeth from the Reticular Plexes of the Arteries filled with Blood, whereupon the numerous Capillaries be- ing distended do approach each other, and seem to make a kind of Tunicle investing the *Adnata*, and sometimes the *Cornea*, whence the Sight is lessened, or wholly taken away.

Bleeding after Purgatives have been premised, may be safely advised in this Disease, proceeding from stagnated Blood, to make good its circulation.

Unguis Oculi.

The cause of the *Unguis Oculi.*

The Cure of the said Dis- ease.

And afterward Topicks may be administered, made of Sugar-Candy, lapidescent *Hamatit*. Prepared, burnt Alome, white Vitriol, Camphor, *Tartar* infused in distilled water of Red Roses, and Eye-bright, of which some drops may be instilled into the disaffected Eye.

Prepared Tutty, and Prepared Pearl, Red Coral Prepared, *Pompholyg*, Sugar-Candy, Camphor made into a fine Powder, may be applied to the discomposed Eye in a small quantity: If the Courteous Reader be desirous to be farther satisfied concerning the *Materia Medica* proper to the Cure of this Disease, I refer him to the Medicines assigned to the *Unguis Oculi*, which is nearly related to the present Malady.

Another disaffection of the *Adnata*, is called by the *Latines*, *Sugillatio*, and by the *Greeks*, *σάκκος διαμαρτυρίας*, and in *English* the Blood-shed of the Eye, which arising from a Blow, or Fall, maketh a Contusion of the Eye, a Laceration of the Capillary Carotide Arteries, inserted into the *Adnata*, whereupon proceedeth a stagnation of Blood in the Interstices of the Vessels, belonging to the White of the Eye; so that it is first hued with Red, and afterward with a blewish colour.

As to the Cure of this Disease, if the Eye be rendred highly Blood-shed in a Body abounding with Blood, and full of Humors, Purging and Blood-letting are very proper; And then Topicks may be duly applied, consisting of gentle discutient and astringent Medicines, made of Water of Strawberries, Red Roses, Honey Socles, Woodbine, Plantain, and Myrtles, &c.

CHAP.

C H A P. XII.

Of the Diseases of the Cornea, and their Cures.

THe *Cornea* is made of a Horney Diaphanous substance for the defence of and constitution of the lucid Orb of the Eye, which else would not be receptive of the visible Images of things, as encircled with Rays of Light.

The Eye more or less loseth its transparency, as the *Cornea* is obscured with greater or less degrees of incrassation, whereby the Tunicle groweth thick in old Persons, caused by overmuch driness, which is incurable.

The disaffection of the Transparency of the Eye and its causes.

The *Cornea* also is rendred opake, when it is clouded by overgross Humors impacted into it, which often happens in an *Opthalmia*, and is sometimes produced by high resolving Medicines, which breath out the more thin parts of the Recrements settled in the *Cornea*, and leave the more gross behind; it is also generated by gross Humors, flowing out of the Termination of the Arteries, and stagnated in the substance of the *Cornea*; whereupon the Sight is lost or lessened, as the *Cornea* is infested with greater or less incrassation of Humors, called by the *Latines*, *Albugo*.

And the *Cornea* is not only incrassated with gross Recrements, but is divested of its Transparency, as hued with strange Colours, and sometimes it is coated with Redness, when the Blood is lodged in the empty spaces of the Vessels, as in Sugillation, wherein the Eye is rendred Blood-shed, and then the Object represented to the Eye, seemeth to be veiled with Red, and sometimes with Yellow, in a Jaundy; wherein the bilious Recrements spued out of the terminations of the Arteries, do tinge the *Cornea*.

If the clearness of the *Cornea* be fouled by pituitous Recrements, it may seem reasonable to use Purgatives first, and afterward to apply Topicks, when the Blood is refined, which is insinuated by the extremities of Capillary Carotide Arteries into the substance of the *Cornea*.

When universal Evacuations have been advised, a Decoction may be made of Mallows, Calamint, Eye-bright, Line-seed, Fanugreek-seed, with the Flowers of Melilote, of which the warm Steams may be received into the disaffected Eye Morning and Evening.

Cures of an *Albugo*.

Learned *Amatus Lusitanus* giveth an account, that he Cured an *Albugo* with Decoctions of *Sarzaparilla*, taken twenty days; in the Interim he advised a destilled Water to be instilled into the Eye made of Honey (immediately after it was taken out of the Comb) and with the Flowers of Eye-bright, Elder, and Sugar-Candy destilled in Milk in *B. M.*

The Seeds of Clary finely searsed, and applied in this case, prove very beneficial to clear up the Eyes, when darkened with gross Humors.

Juice of Fennel mixed with a few drops of Balsam of *Pern*, is of great efficacy in this case; as also Oyl of Burnt Linnen, quenched between two Pewter Dishes, and mixed with a Boy's Spittle, is very successful in a Cure of this Disease; as to a farther Cure, I refer you to the *Materia Medica*, propounded in the suffusion of the Eyes.

The

The Tumors
of the Cornea
and their
Cures.

The Cornea is also liable to small Tumors (somewhat like the Seeds of Millet) called by the *Greeks* *φλύκταιναι*, arising from thin sharp Recrements, destilling out of the Extremities of the Carotide Arteries, into the empty spaces of the minute Vessels lodged in the Cornea, whereupon its Tunicle groweth distended in many places, producing various little Swellings.

The Cure of these Pustles is performed after the same methods as hath been advised in an *Ophthalmia*. *Aetius* commends the White of an Egg and the Yolk beaten up with a little Sugar and Saffron, which may be administred to the Eye in the beginning of the Disease, as also a Quince boiled in Water and mixed with Oyntment of Roses, or a Mucilage of the Seeds of *Psyllium*, and Quinces extracted in Red Rose-water.

In the increase of the Disease resolving Medicines may be used, as a Decoction of the Flowers of Chamæmel, Melilote, mixed with the Seeds of Flax and Fanugreek.

Eye-waters made by destillation of the Leaves of Vervain, Rue, Salendine the Great, Red Rose Leave in Milk, may be instilled into the disaffected Eye.

Waters of Eye-bright and Red Roses mixed with a little Tutty and *Trochisci Alb. Rasii sine opio*, and with White Vitriol in few Grains, have proved successful in this Disease.

The Ulcers of
the Cornea.

The Cornea is not only liable to little Swellings, but Ulcers too, which have had divers appellatives among the *Greeks*, as they are superficial or more deep in the said Tunicle, in which an Ulcer is known, as being the consequent of a white Tumor appearing in the Black of the Eye, and proceedeth often from Contusion, whereby the Blood is imparted to the substance of the Cornea out of the Lacerated Carotide Arteries; other times it is produced by over-sharp Medicines applied to the Eyes, and chiefly from Salt, sharp, and serous Recrements of the Blood, corroding and exulcerating the substance of the Cornea.

As to the Cure of an Ulcer of the Cornea, Purging Medicines may be advised, as also Bleeding in a Sanguine Constitution, and then Defensatives may be administred to the Forehead consisting of Astringents, which do check the flux of Humors into the parts affected.

The Cure of
the Ulcers of
the Cornea.

The Indications, are the same with other Ulcers, and consist of milde, detergent, drying and consolidating Medicines, of Tutty, Red Coral, Aloes, Sarcocol nourished in Milk, which may be put into a Linnen Cloth, and hung in Eye-bright, Fennel or Salendine Water, and after they have been sometime infused and strained, a few drops of the Water may be instilled into the Eye; as also *Hydromel*, and Syrup of dried Roses, being of a cleansing, drying quality, may be of good use in this case.

When the Ulcer is cleansed *Sief. de plumbo Rasii* may be given in any convenient distilled Waters of Salendine the Great, Eye-bright, Fennel, or Roses, as also *Saccharum* or *Oleum Saturni*, may be of great use in this case.

Or let a Liniment be made of Red Coral Prepared, Burnt Harts-Horn Prepared, Cerufs, washed and a few Grains of Crude Antimony, and Honey of Roses strained.

A Collyrium may also be prepared with burnt Lead washed, Tutty Prepared, Gum of *Tragacanth* infused in Eye-water.

A Rupture of
the Cornea.

Another Disease (to which the Cornea is obnoxious) is a Rupture, which is made downward, when the Pus, following an Inflammation, is accumulated in the substance of the Cornea, in so great a quantity that it distends it to a Laceration of the region of the Cornea; or rather the sharp Purulent Matter

Matter corrodes the Tunicle, and is lodged under it, or between it and the *Uvea*, or sometimes it corrupts that Membrane, and is enclosed between the *Uvea* and watry Humor, and other times it is extended to the Crystalline Humor. This Disease is called *ὑπόπυον*, *Pus sub Cornea*.

In this Disease about the beginning Purging and Bleeding may not be amiss, especially in Plethorick Constitutions; and then resolving and emollient Medicines may be used, made of the decoction of Flowers of Chamæmel, Melilote, Seeds of *Psyllium*, and Fænugreek, to which afterward may be added the Leaves of Eye-bright, Salendine the Great, which are very proper to take away the reliques of an Opthalmy, which if neglected, is productive of this Disease, and in order to its Cure, may be applied a *Collyrium* made of Tutty, Prepared Aloes, Sugar-Candy, and a little Myrrh infused in the destilled Waters, of Fennel, Salendine the Great, Rue, Vervain, or Roses, of which a few drops may be instilled into the Eyes.

The Cures of the said Disease.

Sometimes a proper Medicine may be made up of Saffron, Aloes, and Myrrh, in a little Wine and Honey.

In this case when Matter cannot be dissolved by resolving and emollient Medicines, *Galen* and *Ætius* do advise a Puncture to be made in the *Cornea*, as in the suffusion of the Eye, which operation is rarely celebrated of late, and requireth the most dextrous hand of a Skilful Chyrurgeon, lest an Aperition being made in the *Cornea*, the aqueous Humor should flow out with the Purulent Matter.

The Eye as well as other parts of the Body, is sometimes subject to a Cancer, (most commonly seated in the *Cornea*, or *Adnata*) which may be referred to a Tumor, if it be Latent, but if the Tunicle be corroded by the Venenate nature of the Humor, it is termed a Cancerous Ulcer.

A Cancer of the *Cornea*.

The Diagnosticks in both may be an unequal hardness of the *Cornea* or neighbouring parts, a Livide or Lead colour, an intolerable pricking pain, and the Veins appear to be hued with a dark or blackish colour, in the swelling of the Eye, and parts adjacent.

This terrible Disease taketh its rise from Blood, infected with a virulent quality, carried into the *Cornea* by the Extremities of the Carotide Arteries, whence ariseth a Tumor, as the serous parts of the Blood are lodged in the Interstices of the Vessels relating to the *Cornea*, as not entertained into the origins of the Jugular Veins.

The cause of a Cancer.

This Disease if it hath taken a deep root in the part affected, is not to be mastered by the power of Art, and admitteth only a Palliative Cure, which giveth ease, and prolongeth Life.

In the beginning of this Disease gentle Purging is useful and Blood may be taken either out of the Neck or Arm, or by Cupping-Glasses applied to the Shoulder and Neck, or by Leeches to the Neck or Arm, and a slender Diet, consisting wholly of Milk, or of other Suppings, made of Corn, (which are more beneficial than Flesh, which will highten the Disease) as Water-Gruel, Barley-Gruel, or Barley-Cream, *Panada*, &c. may prove very advantageous.

Applications may be made in the beginning of a Cancer in the *Cornea*.

Diet-drinks may be also advised, made of *China*, *Sarzaparilla*, Harts-Horn, and Ivory shavings, Raisins of the Sun stoned, to which may be added the Leaves of Eye-bright, and Vervain, or Mountain Sage.

An Eye-water may be prepared of the Roots of Spoonwort, and of the Leaves of *Robertian* Cranesbill, *Arnoglossa*, Night-shade, Salendine the Great, Eye-bright, young Frogs, and Whites of Eggs, Seeds of Fænugreek, and Quinces; and upon the Roots, Seeds, Herbs, &c. being pounded in a

Mortar, may be poured a sufficient quantity of the distilled water of Eye-bright and Roses; and after a due infusion they may be distilled in a Leaden Alembick, and afterward the Cancr'd Eye may be often washed with this water.

Learned Riviere giveth an account of *Mauritius Cordæus*, *Comment. 7. in Lib. 1. Hippocrat. de morbis Mulierum*. Refert ille *Historiam Nobilis cujusdam foeminae, cui tota pars dextra faciei Cancro, eoque Ulceroso, obsessa fuit diutissime, quæ cum variis auxiliis, à Medicis Italis, Gallis, Germanicis, Hispanis, peritis usa esset, tandem vulgari hoc barbitonsoris remedio sanata est. Pullos Gallinaceos in partes tenues latas concidebat, quas sæpiuscule commutando interdum admovebat parti affectæ. Alii admovent carnes pullorum columbinorum sectas, & adhuc tepidas.*

I humbly conceive that the flesh of Chickens and Pidgeons being applied warm, and often changed, may draw out the malignity of the Cancrous humor, or at least give ease in great pains frequently attending Cancers, and especially those of the Eyes, as being the most tender parts, endued with most acute sense.

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This Dileite if it hath taken a deep root in the part affected, is not to be mastered by the power of Art, and admitteth only a Palliative Cure, which giveth ease, and prolongeth life.

In the beginning of this Dileite gentle Fungus is useful, and Blood may be taken either out of the Neck or Arm, or by Cupping-Glasses applied to the Shoulder and Neck, or by Leeches to the Neck or Arm, and a slender Diet, consisting wholly of Milk, or of other suppers, made of Corn, (which are more beneficial than Flesh, which will lighten the Dileite) as Water-Gruel, Barley-Gruel, or Barley-Cream, Pannada, &c. may prove very advantageous.

Diet-drinks may be also advised, made of China, Sarsaparilla, Harts-Horn, and Ivory shavings, Rains of the Sun stoned, to which may be added the Jucos of Eye-bright, and Vervain, or Mountain Sage.

An Eye-water may be prepared of the Root of Spoonwort, and of the Jucos of *Robur Cranchilli*, *Amigdalæ*, *Nightshade*, *Saladine the Great*, *Eye-bright*, *Young Frogs*, and *Whites of Eggs*, seeds of *Fennugreek*, and *Quinces*; and upon the Root, seeds, Herbs, &c. being pounded in a Mortar

C H A P. XIII.

Of the Diseases of the Uvea, and their Cures.

HAVING discoursed the Disaffection of the *Adnata* and *Cornea*, the two upper Coats of the Eye, it follows in order, that we should treat of the Diseases of the third Coat, the *Uvea*, which is liable to an undue position, called by the *Greeks* *μετὰ πλάσιν*, by the *Latins*, *Procidencia*, which is an unnatural situation of this Tunicle made by the Rupture of the *Cornea*, either by a Wound, or by an Ulcer.

Ægineta hath made four kinds of Procidencia belonging to the *Uvea*, according to its greater or less dimensions; if a small part only be dislocated, he calleth it *μυιοκέφαλον*, as it resembleth in Figure the Head of a Fly; and if a greater portion of it be disseated, he calleth it *σφύλαμα*, as being like the Stone of a Grape, and if the greatest part of it be displaced, it is called *μήλον*, from the Figure of an Apple; and when the *Uvea* hath contracted a callous nature, it is named *ἰλθ*, *Clavus*. This Disease is distinguished from those of the *Cornea*, as a manifest separation of the *Uvea* from the *Cornea* may be discerned, whereas in Nature these Tunicles are nearly conjoined.

The several kinds of Dis-eases of the *Uvea*.

As to the Cure of the Dislocation or Procidencia of the *Uvea*, it denoteth Astringent Medicines (mixed with Specificks relating to the Eye) to reduce the *Uvea*, if possible, into its proper situation, and in this case Medicines propounded in the Rupture of the *Cornea*, are very proper.

All the other Tunicles, are whole Segments, relating to their surfaces, but the *Uvea* being perforated in the middle, doth somewhat resemble a Ring, as the hole is a little Circle through which the resemblances of things, clothed with beams of Light, are received into the body of the Eye, and pass through the various Humors to make appulses upon the *Retina* in order to its Vision.

The Pupil of the Eye appeareth greater or less, as the little Circle is expanded or contracted, according to the various position of the *Uvea*.

If the Pupil of the Eye be too much enlarged, it is called by the *Greeks*, *μωδίασις*, and receiveth this denomination, *à Visione debili & obscura*, by reason the visible semblances of things grow faint and weak, as being overpowred with the more radiant beams of Light, and therefore Nature hath made the inner Chambers of the Eye somewhat dark, that the species of visible Objects arayed with moderate light, might be the better discerned, and therefore hath given power to the *Uvea* to contract the Pupil of the Eye, which is performed by the Fibrils of the Ciliary Processes, to shut out the over-bright Rays of Light, which else would confound the more weak representations of visible Objects, which happens in the too great and unnatural dilatation of the Foramen of the *Uvea*; which hath many causes, and is sometimes produced by an ill conformation from the birth, but most commonly adventitious, and is caused (as divers Physicians will have it) from a tension of the *Uvea*, coming from a dry distemper derived from long Watchings,

The two great Perforations of the *Uvea* is called *μωδίασις*.

ings, Fevers, and the like, other times this Disease followeth from a source of Humors mixed with the Blood and imported by the Carotide Arteries into the substance of the *Uvea*, and enlarging the Pupil of the Eye.

And other times the hole of the *Uvea* is amplified by a quantity of the aqueous Humor extending it, and rendring the Pupil more large.

The external causes enlarging the Perforation of the *Uvea*, may be some stroke, or fall, or retention of the Breath, which is common to Women in Travail, to promote the birth of the Child.

If this Disease proceed from a dry distemper of the Tunicle, it doth denote Restorative Medicines in a Hectick Fever, as also Emollient Medicines to be applied to the Eye, as a Decoction made of Mallows, Marshmallows, Eyebright, &c.

If the Pupil of the Eye be too much enlarged by Blood and Recrements extending the *Uvea*, Purging and Bleeding are very proper, and afterward Astringent Medicines may be administred (to corroborate the Eye and lessen the Foramen of the *Uvea*), made of Red Roses dried, and Prepared Tuty, *Bole-Armenick*, Dragons Blood, put in a Nodule, and infused in Red Rose water, of which being squeezed, some drops may be instilled into the affected Eye.

If the enlargement of the Pupil proceed from a stroke, fall, or any other way of Contusion, Bleeding and Clysters may be advised, and in case of an Inflammation, such Medicines may be used which have been propounded heretofore in the Opthalmy, as also a Pultice may be applied to the Eye made of Bean-Flower, Leaves of Plantain, Red Roses dried, with a sufficient quantity of Rose-water, and afterward some drops of Pidgeons Blood may be instilled into the Eye, which is very good in all wounds and contusions of the Eyes.

The over-
much contra-
ction of the
Pupil.

If the Pupil of the Eye be over-much contracted, it cannot give a due reception to visible Objects, which are best seen in this case in a well enlightened Medium.

When the Perforation of the Eye is over-much lessened, the Sight is rendered dim, and only capable of seeing Objects, directly opposite to the Eye, and those that are placed laterally, cannot be discerned.

If the Eye be long versed in a place full of bright Rays of Light, it is forced to contract its Pupil to shut out the radiant beams, which else would wholly confound the Sight.

The unnatural contraction of the hole of the *Uvea*, sometimes is derived from the birth, and other time from too much moisture imparted in the substance of the *Uvea*, and from the defect of the watry Humor of the Eye, whereupon the *Uvea* sinketh and its Perforation is lessened.

C H A P. XIV.

Of the Diseases of the Watry Humors of the Eye, and their Cures.

THE watry humor of the Eye, when it recedes from its natural disposition, is called by the *Greeks*, *ὑποχύμα*, by the *Latines*, *Suffusio*, when the aqueous Liquor is encreased in dimensions, whereby the dilatation of the Pupil of the Eye is enlarged; or when it offends in quality as it is rendred more gross, it is most properly called *Oculi suffusio*, proceeding from some Recrements of the Blood, destilling out of the Terminations of the Carotide Arteries, and spoiling the native purity of the watry humor; *Galen* is of an opinion that this Disease may be derived from the condensation of it, but this is very rare, and is most commonly produced from the afflux of other gross Humors; the Suffusion of the Eye is vulgarly called *Cataracta*, which is very improper, as the word denoteth, a violent and steep descent of Water, which cannot happen in the Eye.

The increase of the aqueous humor of the Eye is called *Suffusio*.

A *Cataracta* of the Eye.

This Disease may truly be accounted, as relating to the watry humors of the Eye, as it is disaffected by gross Humors (rather than Vapours) seated between the *Cornea* and *Cristalline* humor.

The causes of the said Disease.

Some Physicians assigne another cause of a Suffusion, which is only spurious, and floweth, as they conceive, from Vapours of the Stomach and other parts of the Body disaffecting the Eyes, which seem to represent the Phantasms of Fleas, Flies, and Spiders Webs, flying up and down in the Air; but the most common and true cause of the Suffusion of the Eye, doth not come from Vapours, but excrementitious parts of the Blood, ouising out of the Extremities of the Carotide Arteries (inserted into the *Uvea*) into the watry liquor of the Eye, which groweth more and more discomposed in its function, as the aqueous Humor is more and more incrassated by the recrements of the Blood.

Sometimes this Disease may take its rise in some part from a gross Liquor destilling out of the Termination of the Nerves (implanted into the *Uvea*) into the watry liquor of the Eye, and is more rare, than the other cause, arising out of the recrements of the Blood.

This Disease admitteth many discriminations from the greater or less grossness of the offensive Matter, or from the quantity of it, or from the part affected.

In reference to the various degrees of thickness of the Recrements, the Sight is more or less offended; In the beginning of the Suffusion the Humor is thin and transparent, and giveth less disturbance to the Eye.

And in the increase and state of the Disease, the Recrements of the Blood grow more condensed and opace; so that the visible Object cannot be duly or not at all received into the aqueous and Cristalline Humor of the Eye; And as the quantity of excrementitious Liquor of the Eye is more or less shaded, the Sight is lessened or abolished.

In relation to the part aggrieved, the Humor either affecteth one part of the Pupil, and then the whole Object cannot be discerned; and if the offensive Humor have recourse to the middle of the Pupil, the resemblances of things, appear to the Eye Latise-wise, by reason the Matter clouding the Center of the Pupil, representeth the visible Objects carried to its Margent, as Pinked with many holes.

The Diagnosticks of a true Suffusion of the Eye, is first that a Cloud appeareth in the Center of the Pupil, which is not found in a spurious Suffusion.

Secondly, In it the Symptoms are continued, but those of a Bastard-Suffusion are sometimes better, and other times worse, according to the greater or less Anathymiasis of Vapours afflicting the Eye (which are much less when the Stomach is empty) which represent Fleas, Flies, &c. more or less at several times; and sometimes the Eye is wholly free from such Phantasms, as not at all affected with Vapours; but in a true Suffusion the visible Objects are seen as through a Cloud, or Glass, which is the proper and Pathognomick Symptom of this Disease.

The Prognosticks of a Suffusion.

The Prognosticks may be determined according to the various times of the Disease, by reason *Galen* is of an opinion that in the beginning of a Suffusion (in which the visible images of things may be discovered as through a Glass) the disaffection may admit a Cure, which supposeth Youth and a good disposition of Body, else in Old age, and in an ill habit, the disease for the most part proveth incurable, especially in those that have been subject to a great and long flux of Humors into their Eyes.

The Cures of a Suffusion.

Riviere giveth an account, that in the beginning of a Suffusion he Cured this Disease in a Person above Fifty years of age, by frequent Purgings, and Sudorifick Diet-drinks and Vesicatories, without any application of Topicks.

If this Disease flow from an Inflammation of the Lungs, a Phrensie, or a violent pain of the Head, it is hardly Curable, as also when the Suffusion is Black and void of all transparency, or when it is Green, or Yellowish, or like Quick-silver in colour or motion, or when the Matter is lodged in the Center of the Pupil, (wherein the Objects are represented Latise-wise) there is a small hope of any Cure in a *Cataract*.

A Vein may be opened in a Suffusion.

In the beginning of this Disease in a Plethorick Body, a Vein may be safely opened, and Purgatives also may be advised, mixed with Cephalick, and Specifick Alteratives proper for the Eyes.

And afterward Diet-drinks may be advised, made of *Lignum Sanctum*, *Sarzaparilla*, *Sassafras*, *Salendine the Great*, *Vervain*, *Eye-bright*.

And the Head may be Fomented with a *Lixivium*, in which the Leaves of *Betony*, *Eye-bright*, *Majoran*, *Rose-Mary*, *Lavender* and *Coriander-feed* may be boiled.

And also Cupping-Glasses, Vesicatories, may be applied to the Shoulders and Neck, to which also a *Setum* may be administred.

In order to discuss the offensive Matter, Fomentations by way of Vapours may be used to the Eye, made of *Ground Ivy*, *Eye-bright*, *Valerian*, *Salendine the Great*, &c.

And

And afterward deterfive Medicines may be applied, prepared of White Honey depurated, or distilled Waters of Honey, or Honey of Roses, or Squills; of which some few drops may be instilled into the parts affected, Morning and Night.

Or else take the Leaves of Green Corn, Rue, Pimpernel, Salendine the great, distilled with a little Cinamon and Mace, and a small proportion of White-wine, after a due infusion.

You may take the distilled Water of Salendine, mixed with White Vitriol, and prepared Tutty, in a small quantity, and with a little *Vitrum Antemonii*, and Sugar-Candy.

This Medicine is very much commended by *Galen*, made of the Gall of a Cock, the Blood of a Mouse, mixed with a Womans Milk, which may safely be applied to the Eyes.

Or take of the Leaves of Rue, Fennel, Eye-bright, Salendine the great, the Seeds of Fenugreek, the Flowers of Chamæmel, and Melilot, and let them be boiled in three parts of Fountain Water, and one part White-wine, and let the part affected be bathed with a soft Sponge; or let the fume of this Decoction be received into the Eyes.

Other Medicines also may be of great use in this Disease, which shall be advised in the *Gutta Serena*.

When proper methods of Physick have been administred, and prove altogether unsuccessful, Chyrurgical operations are to be celebrated as the last remedy.

And as I humbly conceive, a Cataract is to be couched after this manner, by first obliging the Patient to turn his Eye inward toward the Nose, and the Needle is to be immitted into the *Adnata*, in the middle between the outward *Canthus* and the *Cornea*, over against the middle of the suffusion, and to be gently handled till it come to the middle of the Pupil, and Cataract, where the Needle is to be quickly turned, till by degrees it is brought below the whole region of the Pupil, and then after some little stay, the Needle is to be lifted up, and not immediately taken away, That the Cataract may rise, and be gently brought away. And immediately after it, the White of an Egg may be beaten up with Rose-water and Alom, and applyed to the Eye, with a little Linnen, to hinder the fluxe of Humors, and prevent an Inflammation.

The manner
of couching
a Catarach.

Sometimes it happens when the Cataract is not ripe, as being not concreted, when it is pricked with a Needle; it runneth about like a milky substance, or a puddle water; whereupon it is discharged, and cannot again coalesce into one body, by reason the Tunicle enclosing it, is broken by the Needle.

C H A P. XV.

Of the Diseases of the Aranea, and the Cristalline and Vitreous Humor, and their Cures.

The grossness
of the *Aranea*.

THe Cristalline Humor of the Eye is every way encompassed with a thin transparent Tunicle, called by the *Latines*, *Aranea*.

This fine Coat is sullied with gross Humors, issuing out of the capillary carotide Arteries inserted into its substance; this disaffection is known when the Sight groweth dimm, as if it were celebrated through a White Vail lying deep in the Eye, which being free from this Disease, when we fix our Sight upon anothers Eye, it maketh the Image of a minute Face in it, which cannot be seen, when the *Aranea* is rendred somewhat Opace, by a thick Recrement.

The Rupture
of the *Aranea*.

Sometimes the *Aranea* is broken by the ill accident of a stroke, or fall, and other times corroded by sharp saline Humors; whereupon this thin Film being spoiled, the Cristalline and watry Humor are made confused, when the fine party-Wall of the *Aranea* is dis-joyned.

The Cristalline Humor confined within the *Aranea*, hath little or no colour, being of a transparent nature, and is beautified with a kind of orbicular depressed Figure; its situation is in the middle, if a line be drawn through the middle of the Pupil to the Origen of the optick Nerve; but in reference to the anterior and posterior region of the Eye, its seat is not in the Center, but inclines somewhat to the fore-part and Pupil of the Eye.

Γλαύκωμα
or ill colour
of the Cristal-
line Humor.

The Cristalline Humor, as losing its native constitution, is liable to diverse Diseases, amongst which the First may be called Γλαύκωμα, when the Cristalline Liquor quitteth its innate disposition, and groweth somewhat Opace, in being turned Greyish or Blewish; whereupon it is not duely receptive of the visible Images of things.

The cause of a
Γλαύκωμα.

The cause of this Disease is, when the Cristalline Humor is somewhat dried and condensed in old age, which is incurable; this Disease may be discerned, by reason a kind of Whiteness appeareth deep in the Eye, through which the Objects are represented to the *Retina*, as through a Cloud or Smoak.

A cause of another Disease, relating to the Cristalline Humor, may be the ill situation of it, when the anterior Region, somewhat resembling the Figure of a large Lentil, is not seated directly opposite to the Pupil, but is too much elevated or depressed; but if one Eye hath the Cristalline Humor duly seated, and the other unduly, all Objects appear double; but if both the Eyes have one kind of ill situation, they only dull the Sight, without any gemination of the Object.

The ill placing of the Cristalline Humor may proceed from some violent motion of a stroke or fall, or from the Birth, by an ill Conformation of the part.

If the Cristalline Humor be divided by some ill accident, the Objects are represented double, in some sort resembling a Looking-Glass broken into diverse parts, which give many Reflections of the same Object, according to the various pieces of Glass.

The

The vitreous Humor of the Eye may recede from its due transparency, as well as the Cristalline, when it loseth its Purity, as fouled by some gross Recrements; Whereupon the visible species cannot be conveyed through it with clearness, to make due Appulses upon the *Retina*; so that the Sight is more or less darkned, as the vitreous Humor groweth more or less opaque.

The grossness of the vitreous Humor.

The undue situation of the vitreous Humor, very much incommodes the Sight, when it is not directly placed against the Pupil.

CHAP. XVI.

Of the Diseases of the Optick Nerves, and the Retina, and their Cures.

THe chief Diseases afflicting the Eye, by reason of the Optick Nerves, is called by the *Latines*, *Gutta Serena*, by the *Greeks* *ἀδυσωσία*, when the Sight is abolished, without any manifest disaffection infesting the Eye, which is produced by many Causes: The First may be an Obstruction flowing from a gross Nervous Liquor, not received into the Origen of the Nerves, seated in the Cortex of the Brain; whereupon the animal Spirits are intercepted in their passage into the *Retina*; so that the Appulses of visible Objects cannot be discerned.

A *Gutta Serena*.

The First cause of a *Gutta Serena*.

The Second Cause of a *Gutta Serena* may be derived from Compression, wherein stagnated Blood, or gross chymous Humors, or Pus in an Apoplexie, may compress the Extremities of the Nervous Fibres, placed in the Cortex of the Brain; whence the current of the Animal Liquor, and Spirits are stopped in their progress through the Optick Nerves, into the seat of Vision.

The Second cause of it.

A Third Cause of the *Gutta Serena* may be fetched from the laceration of the carotide Arteries, inserted into the Cortex, which is overcharged with Blood, compressing the beginning of the Nerves, seated in the ambient parts of the Brain.

The Third cause.

A Fourth Cause may proceed from the Convulsive motions of the Origen of the nervous Fibrils, hindring the influx of the animal Liquor and Spirits into the *Retina*, the subject of Vision.

And the disaffection of the Nerves, is not only the cause of a *Gutta Serena*, but the animal Spirits too, which ought to be Serene, and not mixed with gross and dark Vapours, which spoil the clearness of the animal Liquor, and do destroy, or at least lessen the Sight.

The optick Nerves may be a Fourth cause.

Another Cause of the *Gutta Serena* may be derived from the inordinate motion of the animal Spirits, not being capable to be received into the Origen of the Nerves, seated in the Cortex of the Brain; whereby the Sight is either lessened or abolished, as it is very conspicuous in vertiginous dispositions of the Brain.

A Fifth cause of a *Gutta Serena*, is an irregular motion of the Animal Spirits.

Sometimes a *Gutta Serena* hath happened upon the taking of a violent Vomitory or Purge, highly agitating the nervous Liquor, and Blood, affected with gross Chyme; whereupon the Origen of the Nerves are sometimes

compressed

compressed, and other times obstructed, hindring the progress of the animal Liquor and Spirits, into the Nerves.

The cure of
a Gutta Serena.

The Cure of this Disease is performed by Purging Medicines, discharging the gross Humors settled about the beginning of the Nervous Fibrils; afterward in Plethorick Bodies, Bleeding may be prescribed, which proveth often very effectual in the removal of a *Gutta Serena*.

Apozemes also made of the Flowers of Betony, Rosemary, Sage, Lavender, Lime, Lilly of the Valley, mixed with the Leaves of Eye-bright, Salendine the great, Mountain-Sage; and after the Decoction is made, Millepedes may be infused, which do open the obstruction of the optick Nerves, and clear up the animal Spirits, and refine the gross nervous Liquor.

Also Friction of the outward parts, may be beneficial to thin the Blood, and make good its circulation, to hinder its stagnancy in the Cortex, about the Origins of the Nerves; and to this end Cupping-Glasses may be applied to the Back, Shoulders and Neck.

Blistering Plaisters may be used between the Shoulders, and to the hinder part, and sides of the Neck, to draw off the Humors from settling in the ambient parts of the Brain, where the extremities of the nervous Fibrils are seated.

Cauticks applied to the hinder part of the Neck, do often divert the offensive Matter of the *Gutta Serena* from the Head; or in their place a *Seta-cenm* may be administred, which is of great use in this Disease.

Diet-drinks made of Sarza-parilla, Guaicum, Sassafras, mixed with specifics for the Eyes, often prove very advantageous, as they provoke Sweat, and discharge ill Humors, offensiveto the Nerves, animal Spirits and Liquor.

Electuaries made of Conserve of Roses, Flowers of Betony, Lime, Lilly of the Valley, Conditte *Mirabolans*, Powder of Eyebright, Salendine the great, Vervain, and that of Millepedes, mixed and made up with Syrup of Lime-Flowers, or Lillys of the Valley, may be taken three times a day, drinking after it a draught of a cephalick Apozeme.

To corroborate the Brain and Eyes after other Medicines have been premised, Cephalick Powders may be sprinkled upon the Hair; as also Fumes of the same nature may be received into the Nostrils, and Caps made of Cephalicks and Spices may be very useful in a *Gutta Serena*.

The *Retina*, or Retiform Tunicle is near akin to the optick Nerves, as being a fine Filme made of numerous optick Filaments, curiously spun and interwoven, so that their Coat may be justly styled an expansion of the optick Nerves.

This curious Membrane is the chief Organ of Sight, (to which all the Coats, Humors, and other parts of the Eye are ministerial) as the visible objects make their ultimate Appulses upon it, which perfects and determines the Sight.

This Tunicle hath a peculiar Substance Figure, Situation, Vessels, and Connexion, with the neighbouring parts, which being vitiated the Sight is either lessened or abolished.

The wrinkles
of the Retina.

First its smoothness (which its mucous Matter makes) may be spoiled, so that it may grow unequal and wrinkled, as being contracted, so that it is prominent in some parts, and depressed in others; whence the visible Images are darkly and confusedly represented.

This

This inequality may happen when the optick Nerves (as the *Retina* is their medullary substance dilated) are too much relaxed by the moisture, or dried by heat. The cause of this Disease.

The Density of this Coat may much incommode Vision, which may proceed from drops of gross Liquor, distilling out of the extremity of the carotide Arteries, into the substance of the *Retina*. The Density of this Coat.

C H A P. XVII.

Of the Ear.

HAVING Treated of the rare Structure of the Eyes, as the Organ of Vision, made up of Muscles, Coats and Humors; my design at this time (with your leave) is to entertain you with a fine sight of the neighbouring parts, the Ears, and its rare Compage, as the instruments of Hearing.

The Eyes are seated as Two Watchmen in an eminent station of the highest Apartment, to guard us from ill accidents, and entertain us with pleasant Objects, in order to our support and happiness; and on each side of the Eyes are placed the instruments of Hearing (to cultivate us with Wisdom and Knowledge) that they may be readily perceptive of Sounds conveyed by the orbicular motion of the Air, naturally tending upward. The seat of the Ear.

The All-wise Agent hath made Two Ears (that one being rendered useless by some disease or ill accident, the other may perform its Office) affixed to each side of the *Os Petrosum*, as most apposite for the reception of Sounds.

Each Ear is framed of Two parts, the one outward, which may be discerned by the Eye, and the other more inward is concealed, as having its allodgment in the Caverns of the *Os Petrosum*.

The external part of the Ear being finely expanded, is not the chief Organ of Hearing, but only auxiliary to it, as receptive of, and contracting the Air, the vehicle of sounds, to make stronger Appulses upon the Membrane of the *Tympanum*.

The whole outward Ear being called by the Antients *Auricula*, consisteth of divers parts and names, the thinner, and more large and hard Region, called *Pinna*, or *Ala*, and the more thick and soft is styled *Lobus Auris*. The Ear consisteth of Two Parts.

The *Pinna* being the more thin and large expansion of the outward Ear, is for the most part Cartilaginous, clothed without and within with the *Cuticula* and *Cutis*, and a fine Membrane, interwoven with nervous and carnos Fibrils of a fine Muscle, inserted into the outward Region and hinder part of the Auricle. Pinna Auris cula.

The Cartilage is more unequally thick and hard in its middle, and groweth more thin and soft, as it approacheth nearer to the outward verge of the Auricle, and is formed after a kind of orbicular Figure about the entrance of the auditory passage, which is much enlarged by the outward Auricular Expansion, and in Brutes (as Learned *Casseri* hath observed) it is framed of many circles tied together by a common Membrane. The Cartilage of the Ear.

This

The Stru-
cture of the
Ear.

† T. 12. F. 1. 22.
The Processes
of the Ear.

† T. 12. F. 1. 22.

The Cavities
of the Auri-
cle.

† T. 12. F. 1. 22.

† T. 12. F. 1. 22.
The Lobe of
the Auricle.

The Vessels
of the Auri-
cle.

The use of the
Auricle.

This fine Auricular Structure is curiously wrought with divers Processes and Cavities, rarely intermingled, and lodged within each other.

The Processes of the Auricle are Two, *Helix* and *Anthelix*; the *Helix* riseth near the Lobe of the Ear, and ascendeth in a semicircular Figure, about the greatest part of the circumference of the Auricle, dressing it like a Fringe.

The other more inward Process being opposite to the *Helix*, is therefore called *Anthelix* †, in some degree answereth the other in Model, as being somewhat alike in a kind of semicircular Figure, and are in other respects different, as the *Anthelix* is more hard, and less in circumference.

The Auricle is beautified with Three Cavities, the Two uppermost are lodged between the Two Processes of the Ear, as their proper boundaries, and the highest and greater is placed in the upper part of the *Pinna*, between the *Helix* and *Anthelix*, and is named by *Casseri* *Placentinus*, the *Scapula* or *Navicula* of the Ear.

The Second or middle Cavity, called *Concha*, † being seated below the *Anthelix*, in the middle of the *Pinna*, is less in circumference than the former; and these seem to be two distinct Cavities, but in truth are but one common Cavity, as holding intercourse one with another. The First windeth under the inward Flexure of the *Helix*, and then passing on, the *Anthelix* bendeth its course afterward under the inward Verge of the *Anthelix*.

And the reason (as I conceive) why the highest Cavity meeteth with the middle, is the more ready to convey the Air, the vehicle of Sound proceeding out of one *Sinus* into the other, and thence into the Third Cavity, the entrance of the Auditory passage.

The Lobe † is the most pendulous and lowest part of the Ear, exceeding the *Pinna* in thickness and softness, as having a substance more like Fat than Flesh; and is perforated in Persons of quality, in order to be adorned with costly Pendants and Jewels.

The Auricle hath its connexion with the *Os Petrosum*, to which it is fastened with a most firm Ligament, which is propagated from the *Pericranium*, whence it tendeth toward the *Processus Mammiiformis*; and ariseth with Five or more Roots or Origins, which approaching near the Auricle, grow into one Trunk, implanted into the top of the gibbous part of the outward Ear, strengthening and assisting the Cartilaginous Region (to detain it more firmly from falling downward) which constitutes the upper and larger part of the Auricle, rendring it open by Expansion, and is fixed to the *Os Petrosum*, by a strong ligament, propagated from the *Pericranium*.

The Auricle is furnished with Three kinds of Vessels, Arteries derived from the Carotides, Veins from the external Jugulars, and Nerves principally derived from the Vertebrales of the Neck, and from the harder Branch of the Fifth pair; coming from the *Medulla oblongata*, and are dispersed into the sides and gibbous part of the Tunicle.

The outward Ear being made up of many Substances, Processes, and Cavities, is not formed only for Ornament and Security of the inner Ear, but is consigned by nature to other more excellent ends. The Auricle being elegantly expanded at the entrance of the Ear, is endued with Concave Flexures, at the same instant, as well to break the violent motion of the Air, as to give a handsome reception to Sounds, which are conserved a little space in these Cavities, where they sport themselves in these concave Meanders, and thence are readily conveyed into the Auditory passage. The Auricle upon this account contributes much to the distinctness and quickness of

of Hearing, of which they have a sad experience, whose Auricles are cut off by Wounds, or lost by Diseases, which expose the Patient to the doleful penance of a confused, and dull hearing of Sounds, which being immediately represented to the inward Ear, do resemble the troublesome murmures of running streams of Water, or the unpleasant musick of a singing Grasshopper.

The inward Ear, being the principal Organ of Hearing, is seated in the *Os Petrosus*, and consisteth of many parts, the *Meatus auditorius*, *Tympanum*, and Four small Bones, *Malleus*, *Incus*, *Stapes*, *Os orbiculare*, *fenestra rotunda*, and *Ovalis*; as also the Two Cavities of the *Labarintus* and *Coclea*.

The inward Ear.

The Auditory passage † may be styled a Pipe, made for the conveyance of Air, tuned with variety of Sounds, and taketh its rise from the *Concha*, the Second Cavity of the Auricle, and terminates in the *Tympanum*; It is endued with a round Figure, somewhat larger in the first entrance, and groweth a little less toward the *Tympanum*, where it endeth, and passeth thither from the *Concha* in a winding course, through which it is covered, all along within a thin Membranous Vail, derived from the *Pericranium*.

† T. 12. F. 3. 4.
The Auditory passage.

This crooked Duct somewhat ascends, to prevent the fall of some troublesome Matter from without, and that the violent Appulses of Sounds may be somewhat Retunded, least they should offend the tender Membrane belonging to the *Tympanum*.

In this passage is lodged a Yellow, thick viscid Recrement, called *Cerumen*, from the likeness of Wax, and the passage *Alveare*, from a Bee-hive, as it is conceived.

In the close of the Auditory Cavity is found the Membrane of the *Tympanum*. † *Westlingius* calleth it an Expansion of the *Periosteum*; And *Casseri* *Placatinus* affirmeth it to take its rise from the *Pericranium*, which he proveth by Autopsy, as having seen in Infants, the Membrane of the *Tympanum* hanging out of the Auditory passage; and the *Os Squammosum* continued, and fastned to the *Pericranium*.

The Membrane of the Tympanum.
† T. 12. F. 2. 6.

This Membrane is most dry and thin, resembling a Cobweb in great fineness, and is very smooth both without, and in its upper and lower Surface, and transparent like a Looking-Glass, and is not tied, only according to its circumference (except in the upper Region where it is somewhat loose) to the *Annulus Osseus*, but is also basted cross-ways toward the Center with a nervous Cord, or Ligament annexed to it.

The description of the Membrane.

This Membrane is a fine contexture, made up of very small nervous Filaments, coming from the auditory Nerves, giving it a most exquisite Sensation.

The description of the Membrane.

Sometime the *Tympanum* is invested with a single, and other times with a double Membrane, and is rarely incrusted with an excrementitious lentous Matter, which occasioneth Deafness, or at least dulness of Hearing.

In the upper *Sinus* of the Auditory passage, Nature hath curiously interwoven a thin Muscle with the Coat of the Membrane, which is called *Musculus Externus* † taking its rise in a fine Expansion, adorned with small carious Fibrils, which running gradually less and less, are carried contiguous to the Membrane of the *Tympanum*, with a slender Tendon to the *Malleus*; That the Membrane of the *Tympanum* being drawn upward, and outward by the contraction of the curious Muscles might be rendred more tense in its upper Region, to preserve the sound more entire, and transmit it to the inward Recesses of the Ear, the *Labarintus* and *Coclea*.

The external Muscle of the Ear.
† T. 12. F. 2. 4.

† T. 12. F. 2. cc.
The internal
Muscle of the
Ear.

The *Musculus internus* is lodged in the *Os Petrosus*, and borroweth its beginning, where the *Processus Petrosus* is in conjunction with the *Os Sphenoides*, and is branched with a double Tendon into the Shorter Process and Neck of the *Malleolus*; so that this Muscle being inserted into it, draweth it inward, and forward with the Membrane of the *Tympanum* affixed to this Muscle; whereupon this Membrane is stiffened by the various contractions of the outward and inward Muscle, as Two Antagonists; The First Muscle draweth outward and upward, and the other draweth it inward and forward, whence these contrary outward and inward motions do balance each other, and by bracing the Membrane, do render it Tense, and fit to entertain the Appulses of Sounds.

The Tympanum of the Ear.

The Bones of the Ear.

The Bony circle being stripped off and the Membrane firmly adhering to it, a large Cavity presenteth it self, called by the Antients *Antrum*, and by the modern Anatomists *Tympanum*, whose inward surface is rough and unequal, made by many Processes and *Sinus*.

In this Cavity may be discovered Four Bones (destitute of any *Periostium*, mutually conjoyned by the mediation of Ligaments,) *Malleus*, *Incus*, *Stapes*, and *Os Orbiculare*, which are little in quantity, but great in use, and various in Figure in all Animals: A Goose hath only Two, a *Malleolus*, and an oblong *Stapes*, or rather an *Incus*, whose shape resembleth in Figure the Basis of the *Stapes*.

† T. 12. F. 4. d.
The Malleus,
or First Bone
of the Ear.

The *Malleus* † is seated within the Membrane of the *Tympanum* in the upper and hinder part of the Bony Circle; and is furnished with a round Head, to which a smaller part is appendant, in some manner resembling a Neck: And somewhat further in the middle, this Bone is adorned with Two Processes, the one is short, into which is inserted the inward Muscle of the Ear; but the other Process is more long and slender, which resteth upon the Orbit of the *Tympanum*. The other Process of the *Malleus*, some Anatomists compare to a Stalk, or Tail, which crooking it self inward, rendreth the Membrane of the *Tympanum* (to which it is fastned) somewhat Concave in its outward Surface, and Convex in its inward.

This Bone in its oblong Head, is loosely articulated, with the *Incus*, and in its Stalk or Termination is strongly fastned to the Membrane of the *Tympanum*, to guard it against the too too impetuous Appulses of Air.

† T. 12. F. 4. b.
Incus, or Second Bone.

And to secure the *Malleus* in its proper situation, Nature hath formed another Bone, called *Incus* † framed above, of a broad, thick, and unequal part, and protuberant forward, and in its upper Region containeth a *Sinus*, adapted to the reception of the *Malleolus*: But in the lower Region the *Incus* emitterh two long, slender, acute Processes, somewhat distant from each other, the one being shorter, leaneth upon the hinder part of the Cavity of the *Tympanum*; the other more long Process, hath a superficial Cavity, to which the head of the *Stapes* is loosely conjoyned by a strong Ligament.

† T. 12. F. 4. c.
The Stapes,
or Third
Bone of the
Ear.

The *Stapes* is the smallest of the Three Bones; in Beasts it is endued with a triangular Figure, like a Δ ; But in Men its little round head (is annexed above to the *Incus*) from which are derived two small Shanks or Processes, hollowed like Arches, supported by a thin porous transverse Base, which doth close the *Foramen Ovale*, by reason the Base of the *Stapes*, doth answer it in Figure and circumference, to which it is fastened with a loose lentous Ligament; so that it may be with ease drawn inward, but not lifted up, or put outward without offering a violence to it.

Os Orbiculare,
or Fourth
Bone.

The Fourth Bone called *Os Orbiculare*, is minute and round, whence it hath its determination, and is tied with a Ligament to the side of the *Stapes*, where

where it is affixed to the *Incus*. *Lindanus* calleth this Bone *Coclear*, of which I cannot imagine the reason, seeing it is of a round shape, and not like a Spoon of a Concave Surface on one side, and a Convex on the other; he also assigneth it Three Processes, which are so small, that they are scarce discoverable.

Having given a description of these fine small Bones, lodged in the *Tympanum*, I will make bold to give an account of their Origination too.

In the Fifth Month of the *Fetus*, in the inward Region of the *Os Petrosum*, are formed Three small Bones, the one resembling a Pear, is joyned in its Cone to the *Os Squamosum*: The Second is decked with an Oval Figure, and is separated from the other by the interposition of a Cartilage: The Third is so little, that it exceeds not a Pins-head in dimensions.

These Three curious Bones, appear affixed to the *Tympanum*, the *Malleus* in its larger part is rendred Bony, while the longer Process remaineth Cartilaginous; and then the *Incus* groweth all Bony, except its extremity, which is grissley; The Base of the *Stapes*, and both its Shanks are turned Bony, resembling rather in its upper Region the Segments of a Circle, then an *Isocles*, with which it is endued, when it arriveth to more perfection, and its ultimate Figure.

The Fourth Bone of the *Tympanum*, styled *Os Orbiculare*, being a round small Bone, first discovered by Learned *Sylvius*, and may be seen in a boiled Calves Head; but cannot (saith curious *Kerkingius*) be found in the Ear of a *Fetus*.

In the Fifth and Sixth Months, the *Malleus Incus*, and *Stapes* are fully accomplished in their Figure, and partly in their substance.

As to the use of the fine Bones lodged in the *Os Petrosum*, I conceive one may be this, That they being seated near the Membrane of the *Tympanum*, may guard its tender Contexture against the violent motion of the Ambient, or inward Air, by preserving it in its proper situation, lest it should be obnoxious to Laceration, as too much extended. Whereupon the Membrane of the *Tympanum* leaneth upon the *Malleus*, according to its inward Surface, to which it is fastened to detain it in its due place, without violation: The *Malleus* is also assisted with the *Incus* and *Stapes*, as Auxiliaries to it, in order to the preservation of the Tunicle of the *Tympanum*, against the incurfion of inward Air, as *Casseri* *Placentinus* will have it. *Ait ille, lib. 4. Cap. 9. Pag. 260 Quando agitatione ac impulsu Aeris interni Tympanum, & Malleus extrorsum aguntur, Incus egressum Mallei, cui per ginglymon Coarticulata est, dum ad præfinitam pervenit metam, terminat. Caterum in eo motu Malleus valide Incudem comprimit: unde hæc duabus apophysibus, tanquam fulcris donata est; altera Offi Petroso, versus mastoideis antrum, annitente, altera longiuscula Stapedis acie perbelle ac eleganter firmata.*

In the middle of the Cavity, relating to the *Tympanum* may be discovered Two holes, the higher is adorned with an Oval Figure †, and is closed before by the Base of the *Stapes*; and in its hinder part hath an Aperture into the *Labarintus*.

The other hole is less, and seated lower, and being endued with a round shape † always keepeth open, as having no covering, and is divided into Two Channels (by the mediation of a Bony Scale) of which one tendeth toward the *Coclea*, and the other toward the *Labarintus*.

The *Labarintus* † is much less in Dimensions then the *Tympanum*, and receiveth this denomination, upon the account of many semi-circles (clothed with a fine Membrane) returning by diverse Meanders into the same Cavity,

The Origin
of the Bones
of the Ear

†. T. 12. F. 3. b.
The higher
hole of the
Tympanum.

The lower
hole of it.
†. T. 12. F. 3. d.

†. T. 12. F. 5. bb
The *Labarintus*
of the
Ear.

into

into which the Oval hole is opened, and is pervious by many others, of which one discovereth it self into the termination of the broader Gyre of the *Coclea*.

The other holes of the *Labarintus* are so small, that they scarce give a reception to a Hair, and through which the minute Fibrils of the auditory Nerve do pass into the thin Membrane, encompassing the Gyres

†. T. 12. F. 7. a.
A Cavity of
the Ear, cal-
led *Coclea*,
consisting of
divers Flex-
ures.

†. T. 12. F. 7. b.

Another Cavity hath the Appellative of *Coclea* †, *Coclea similitudine in spiras Contorta*, and is less then the *Labarintus*, and having Two or Three spiral Flexures, after the manner of a Screw, is encompassed by a thin Membrane, as with a Vail, into whose substance by Three or Four small holes, are received many Fibrils (propagated from the auditory Nerve † twining about the *Coclea*) the immediate Organ of Hearing.

The end of
the many
Meanders of
the Ears.

The various Cavities engraven in the *Os Petrosum* (as the *Labarintus* and *Coclea*) are furnished with several Gyres, to give a check to the impetuous motion of the innate Air (violently reverberated by the Membrane of the *Tympanum*, acted with the strong Appulse of the ambient Air) least it should discompose the tender Fibrils of the Auditory Nerve, seated in the Tunicle of the *Coclea*.

The use of
the Cavities
of the Ears.

Moreover (I humbly conceive) the Cavities of the *Os Petrosum* are instituted by Nature to preserve the sounds first made in the outward Air, and afterward repeated in the innate Air, which are a Cylinder composed of many *Radii*, and do move after a Pyramidal Figure, and are contracted into a Cone, when they pass through the *Foramen Ovale* into the *Labarintus*, and the *Fenestrella rotunda* into the *Coclea*, to make a more distinct Appulse upon the Membrane of the *Coclea*.

CHAP.

The Twelfth Table, Appertaining to the Ears of Man and other Animals.

between either part of the Auditory

Nerve.

A. Another Nerve, called Cerebrum by the

Antients.

B. The Foot of the two Cerebra, leading

to the Labyrinth.

Fig. 7.

The Cerebrum is represented

A. The Nerve winding like a thread about

the Cerebrum.

B. The Nerve of the Cerebrum.

C. The Nerve of the Auditory

Nerve.

Fig. 8. A. Nerve of the Ear of a Horse.

B. A branch of the Nerve, running through

a sinus, and entering the Labyrinth.

C. A Nerve, which is said to be in the

middle of the Labyrinth.

D. The Nerve, which is said to be in the

middle of the Labyrinth.

E. The Nerve, which is said to be in the

middle of the Labyrinth.

F. The Nerve, which is said to be in the

middle of the Labyrinth.

G. The Nerve, which is said to be in the

middle of the Labyrinth.

H. The Nerve, which is said to be in the

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I. The Nerve, which is said to be in the

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W. The Nerve, which is said to be in the

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X. The Nerve, which is said to be in the

middle of the Labyrinth.

Y. The Nerve, which is said to be in the

middle of the Labyrinth.

Z. The Nerve, which is said to be in the

middle of the Labyrinth.

Fig. 1.

The part of the Ear called the

Pinna.

A. The part of the Ear called the

Pinna.

B. A Nerve, called the

Pinna.

C. A Nerve, called the

Pinna.

D. A Nerve, called the

Pinna.

E. A Nerve, called the

Pinna.

F. A Nerve, called the

Pinna.

G. A Nerve, called the

Pinna.

H. A Nerve, called the

Pinna.

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W. A Nerve, called the

Pinna.

X. A Nerve, called the

Pinna.

Y. A Nerve, called the

Pinna.

Z. A Nerve, called the

Pinna.

A. A Nerve, called the

Pinna.

B. A Nerve, called the

Pinna.

C. A Nerve, called the

Pinna.

D. A Nerve, called the

Pinna.

E. A Nerve, called the

Pinna.

Fig. 2.

The Nerve, moving the

Membrane

with the Malleolus

inwards.

A. The Nerve, moving the

Membrane

with the Malleolus

inwards.

B. The Nerve, moving the

Membrane

with the Malleolus

inwards.

C. The Nerve, moving the

Membrane

with the Malleolus

inwards.

D. The Nerve, moving the

Membrane

with the Malleolus

inwards.

E. The Nerve, moving the

Membrane

with the Malleolus

inwards.

F. The Nerve, moving the

Membrane

with the Malleolus

inwards.

G. The Nerve, moving the

Membrane

with the Malleolus

inwards.

H. The Nerve, moving the

Membrane

with the Malleolus

inwards.

I. The Nerve, moving the

Membrane

with the Malleolus

inwards.

J. The Nerve, moving the

Membrane

with the Malleolus

inwards.

K. The Nerve, moving the

Membrane

with the Malleolus

inwards.

L. The Nerve, moving the

Membrane

with the Malleolus

inwards.

Fig. 3.

A. Part of the Auditory passage leading to

the Tympanum.

B. The part of the Tympanum in which

the Malleolus is placed.

C. The part of the Tympanum in which

the Malleolus is placed.

D. The part of the Tympanum in which

the Malleolus is placed.

E. The part of the Tympanum in which

the Malleolus is placed.

F. The part of the Tympanum in which

the Malleolus is placed.

G. The part of the Tympanum in which

the Malleolus is placed.

H. The part of the Tympanum in which

the Malleolus is placed.

I. The part of the Tympanum in which

the Malleolus is placed.

J. The part of the Tympanum in which

the Malleolus is placed.

K. The part of the Tympanum in which

the Malleolus is placed.

L. The part of the Tympanum in which

the Malleolus is placed.

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the Malleolus is placed.

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the Malleolus is placed.

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the Malleolus is placed.

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the Malleolus is placed.

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the Malleolus is placed.

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the Malleolus is placed.

S. The part of the Tympanum in which

the Malleolus is placed.

T. The part of the Tympanum in which

the Malleolus is placed.

U. The part of the Tympanum in which

the Malleolus is placed.

V. The part of the Tympanum in which

the Malleolus is placed.

Fig. 4.

A. The Malleolus.

B. The Bone called I.

C. The upper part of the Tympanum.

D. The lower part of the Tympanum.

E. The part of the Tympanum in which

the Malleolus is placed.

F. The part of the Tympanum in which

the Malleolus is placed.

G. The part of the Tympanum in which

the Malleolus is placed.

H. The part of the Tympanum in which

the Malleolus is placed.

I. The part of the Tympanum in which

the Malleolus is placed.

J. The part of the Tympanum in which

the Malleolus is placed.

K. The part of the Tympanum in which

the Malleolus is placed.

L. The part of the Tympanum in which

the Malleolus is placed.

M. The part of the Tympanum in which

the Malleolus is placed.

N. The part of the Tympanum in which

the Malleolus is placed.

O. The part of the Tympanum in which

the Malleolus is placed.

P. The part of the Tympanum in which

the Malleolus is placed.

Q. The part of the Tympanum in which

the Malleolus is placed.

R. The part of the Tympanum in which

the Malleolus is placed.

S. The part of the Tympanum in which

the Malleolus is placed.

T. The part of the Tympanum in which

the Malleolus is placed.

Fig. 5.

A. A part of the Cavity of the Cochlea

passing to the Labyrinth.

B. The Cavity of the Labyrinth.

C. Four holes opening themselves into

the Cavity of the Labyrinth.

D. The Cavity of the Labyrinth.

E. The Cavity of the Labyrinth.

F. The Cavity of the Labyrinth.

G. The Cavity of the Labyrinth.

H. The Cavity of the Labyrinth.

I. The Cavity of the Labyrinth.

J. The Cavity of the Labyrinth.

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L. The Cavity of the Labyrinth.

M. The Cavity of the Labyrinth.

N. The Cavity of the Labyrinth.

O. The Cavity of the Labyrinth.

P. The Cavity of the Labyrinth.

Q. The Cavity of the Labyrinth.

The Twelfth Table, Appertaining to the Ears of Man and other Animals.

Fig. 1.

- a a.* **T**He part of the Ear called *Helix*.
b b. The part of the Ear called *Anthelix*.
c c. Another called *Tragus*.
d d. A fourth *Antritragus*.
E. A fifth, named the Lobe of the Ear.
f f. A sixth called *Concha*.
g. A Muscle the Elevator of the Auricle.
h. A Muscle having a treble Tendon drawing the Ear obliquely.

Fig. 2.

- a.* The Muscle moving the Membrane with the *Malleolus* outwardly.
b. The Membrane of the *Tympanum*.
c c. The Muscle moving the Membrane with the *Malleolus* inwardly.
d. The Head of the *Malleolus*.

Fig. 3.

- a.* Part of the Auditory passage leading to the *Tympanum*.
b. The part of the Cavity in which
c. The Oval hole (the *Stapes* being removed) is visible.
d. The round hole of the same Cavity.

Fig. 4.

- a.* The *Malleolus*.
b. The Bone called *Incus*.
c. The upper part of the *Stapes*.
d d. The Flexure of the *Coclea*.

Fig. 5.

- a a.* A part of the Cavity of the *Coclea* passing to the *Labarintus*.
b b. The Cavity of the *Labarintus*.
c c c c. Four holes opening themselves into Circles shaded with Black Spots.

Fig. 6.

- a b c d.* The end of the *Meatus* into which the Auditory Nerve is admitted.
b. The *Sinus*, in which a part of the Auditory Nerve is placed at the Center of the *Coclea*.
c. An *Apophysis* seated like a Bridge be-

tween either part of the Auditory Nerve.

- d.* Another *Sinus*, called *Cæcum* by the Antients.

- e e.* The Footsteps of two Circles tending to the *Labarintus*.

Fig. 7.

- a.* The *Coclea* clearly represented.
b. The Nerve twining like a thread about the *Coclea*.
c. The hole of the *Coclea*.
d. The greater branch of the Auditory Nerve.

Fig. 8. Relating to the Ear of a Horse.

- a.* A branch of a Nerve running through a *Sinus* engraven in the *Os petrosum*.
b. A little round Muscle seated in the *Os petrosum*.
c. The round Hole, the beginning of the *Labarintus*, to which the *Stapes* is adjacent.
d. The hole making the Duct of the *Coclea*.
f. The Body and Figure of the *Coclea*.
g. The *Os petrosum*.

Fig. 9. Relating to a Sheep.

- a.* The hole of the *Labarintus*, called the *Fenestella ovalis*.
b. The *Fenestra Coclea*.
c. The Figure of the *Coclea*.

Fig. 10. Relating to an Ape.

- a.* The Auditory passage half opened.
b. The *Foramen Ovale*, placed at the *Labarintus*.
c. The *Foramen* of the *Coclea*.
d. The Figure of the *Coclea*.

Fig. 11.

The Bones of the Ear of a Dog.

Fig. 12.

The Bones of the Ear of a Horse.

Fig. 13.

The Bones of the Ear of a Calf.

Fig. 14.

The Bones of the Ear of a Man.

Fig. 1.

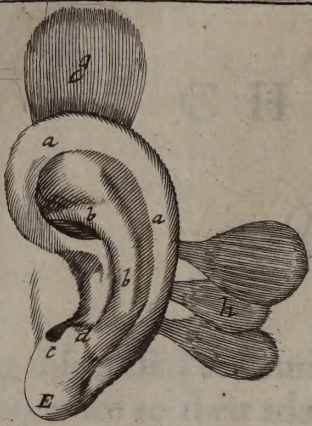


Fig. 2.

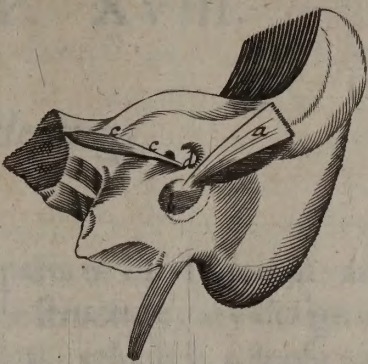


Fig. 3.



Tab. 12.

Fig. 4.



Fig. 5.

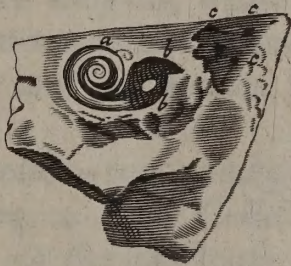


Fig. 6.

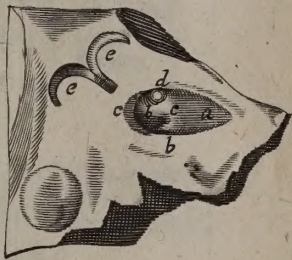


Fig. 7. of a Calfe.

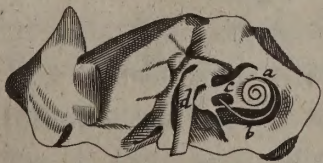


Fig. 8.



Fig. 9.



Fig. 10.



Fig. 11.

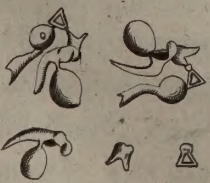


Fig. 12.



Fig. 13.

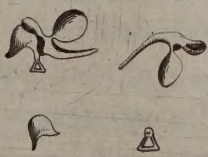
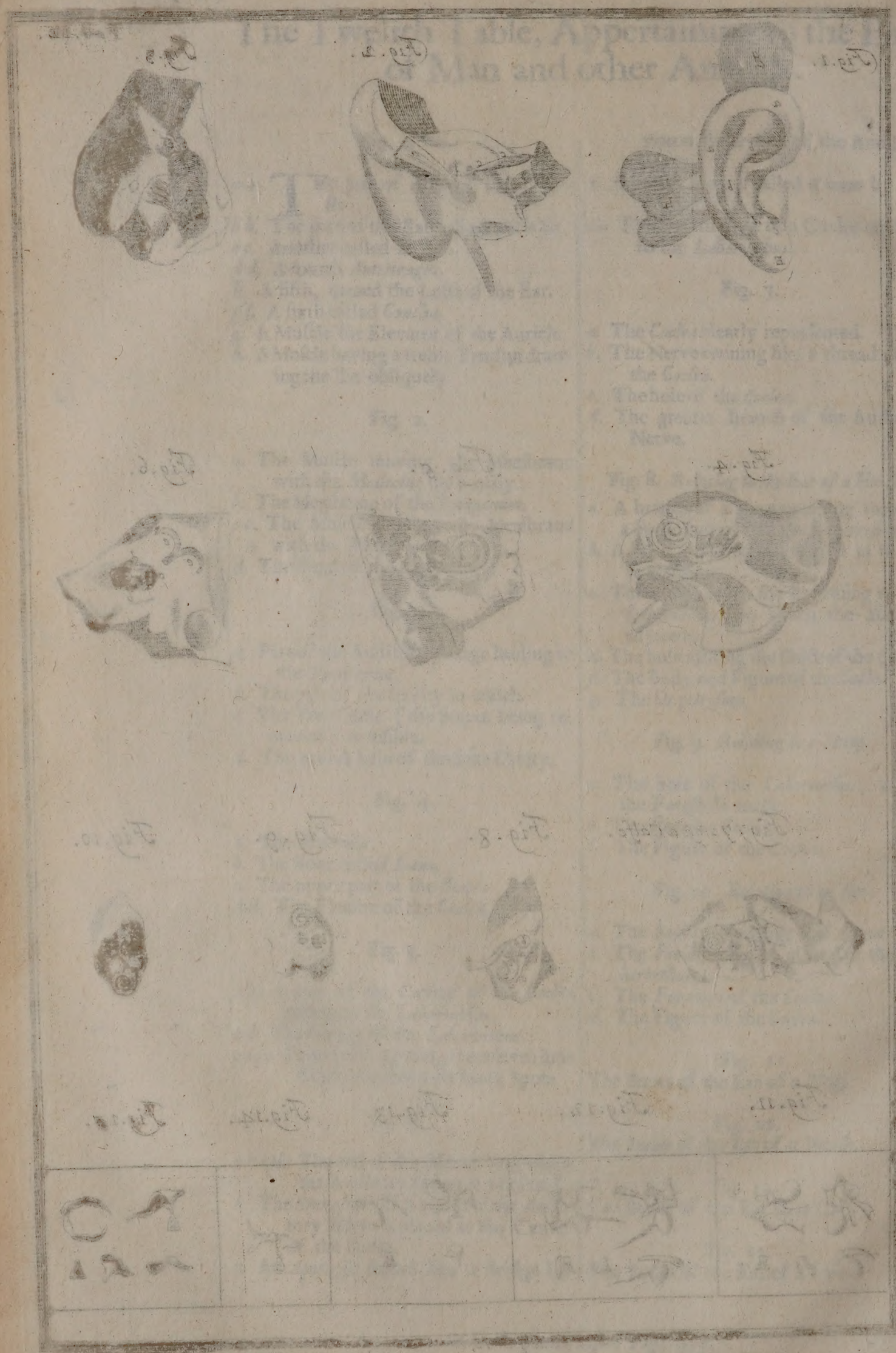


Fig. 14.



Fig. 15.





C H A P. XVIII.

Of Hearing.

Hing discoursed the curious parts of the External and Internal Ear, in reference to their admirable structure; my design at this time is to Treat of them as subservient to Hearing, which is a Sense as noble as useful, styled *Sensus Disciplinæ*, by which others communicate to us, the speculative Principles of Sciences, and the more practical Precepts of moral Philosophy, rendring us Wise, Skilful, and Virtuous.

By this pleasant Sense we carels each other in civil Converſe, imparting our Souls, by affecting our Ears with vocal Sounds (variously modelled by the Organs of Speech) as so many different Characters, expressing the many inward Conceptions, and Passions of the Mind.

The several kinds of Sounds.

The Sense of Hearing is determined by Objects, either taken in a common notion of Sounds in general, or in a more particular and excellent kind of Sounds, of significant Words, which are the various modifications of humane Voice.

The description of Sounds.

As to the Sounds in general, they are loud or low, and greater or less, as the surfaces of solid Bodies make strong or faint Collisions upon fluid. Whence it cometh that Wooll, Spunge, or the like loose and porous substances, receive Air into their Cavities, making gentle, or no reverberations of it, productive of little or no sound.

The manner how Hearing is celebrated.

For Sounds are percussions of solid upon fluid Bodies; whence the parts of Air being subtle, are easily broken against a more compact substance, by reason Fluids consist of many minute Particles, and as being verberated, receive various Configurations of Sounds, which being first conveyed to the Auricle, and afterward to the inward Ear, make different Appulses upon the sensory of Hearing. And the production of it may be celebrated (as I humbly conceive) after this manner: Sounds are the repercussions of Air upon solid Bodies; whereupon Air being made of fluid and subtle Particles, when reverberated from its center of motion, quickly diffuseth it self into an Orb, in some sort resembling the motion of Water, into which a heavy Body being injected, it commenceth its motion in small Circles, which more and more enlarge themselves, till they arrive their utmost confines: And this seemeth somewhat to favour this Hypothesis, that Auditors seated in a great Towre, have Sounds, the configurations of moving Air, conveyed by a kind of oblique Rays to all parts of the Orb in which the Hearers are placed, else they were not capable of Hearing, which is made good by experience, by reason all persons hear Sounds in such an Orb, that hath not too great a circumference, else when the motion of Air cannot reach its Dimensions, it maketh faint or no Appulses upon the inward Organ of Hearing.

Vocal Sounds, or Words, how they are formed.

The noble and significant sounds of words, made up of various Elements of Speech, are the expresses of the Mind, and receive the First, and more rough draughts in the *Larynx* after this manner; The strong impulse of expired Air, running in an even current through the smaller Pipes of the *Bronchia*, and greater channel of the *Aspera Arteria*, till it arrive to the ex-

tremity and head of it, where the confined Breath groweth curled, as receiving greater or less vibrations against that of the Cartilages, called *Arytænoides*, rendered more or less stiff by the Contractions of the *Musculi Thyroarytænoidei*, *Arytænoidei*, *Cricoarytænoidei*, *Laterales* & *Postici*; the Clausors and Apertors of the *Rimula*, by whose various motions of Contraction and Aperture (as by so many stops) are found many discriminations of sounds, the rudiment of Letters, and Words, made of modelled Breath, first vocalized in the *Larynx*, and being thence transmitted to the Mouth, receiveth repeated repercussions against the sides of the arched Palate, which giveth to the sound of the Voice new accessions of increase and sweetness, and rendereth it Articulate (as its great accomplishment) by the Organs of Speech, making the more perfect Configuration of the Voice, the most choice model of expired Air, which is thence conveyed by a quick undulating motion, through the diverse Mæanders of the Auricle, and spiral auditory passage, to the *Tympanum* of the Ear, which being well braced by the Muscles of the Ear, drawing by various motions the Membrane, inwardly and outwardly at the same time, which rendereth it Tense, and in a fit capacity to receive the several Appulses of articulate Sounds (upon the Surface of the Membrane) which make the same Configurations of the voice upon the Contiguous parts of innate Air, which moving after a Pyramidal Figure (whose Base is toward the *Tympanum*, and the Cone toward the *Fenestra Ovalis*) through the contracted model of innate Air, is transmitted into the *Labarintus*, and from thence through the *Fenestra rotunda*, into the spiral *Meatus* of the *Coclea*, invested with fine Membranes, interwoven with various Fibrils of Nerves; so that Appulses being made of the innate configured Air, upon the thin Tunicle covering the *Coclea*, the sensation of Hearing is immediately and ultimately exerted: The manner of it may seem with some probability to be expressed by Sounds, which briskly recoiling from solid Bodies, do move the Air with so much agility, that in a moment its numerous subtle configured parts do enter into the Auditory passage, and immediately make many Appulses, First, upon the several parts of the outward surface of the Membrane, relating to the *Tympanum*.

And every particle of the outward modelled Air, maketh the like impression upon the subtle Atomes of the innate Air, whose most near parts, contiguous to the inside of the Membrane of the *Tympanum*, are first compressed (after the same Configurations of the outward Air) and afterward other parts of innate Air, are successively protruded in order one after another, till the most inward Atomes do make appulses upon the Membrane of the *Coclea*, beset with nervous Fibrils; so that the diverse parts of the Coat belonging to the *Tympanum*, are moved with the several strokes of external configured Air (contained within the *Labarintus*, and *Coclea*) giving vibrations upon the tendrels of Nerves, interwoven with membranous Filaments, in the Tunicle of the *Coclea*.

The Appulses made of divers motions of modelled external Air, upon the Membrane of the *Tympanum* above, and of the innate Air, upon the Tunicle of the *Coclea* below, may be illustrated by a well-braced Drum, whose Head and Bottom being covered with a Skin of Velome; and the upper one being struck, the Air inclosed between the Two coverings is beaten backward, giving a forcible vibration upon the opposite Membrane, which is plainly evident from the motion of the Cords begirting it: And every Particle of the upper Membrane of the Drum, receiving the stroke of the stick, repelleth every part of the confined Air, which moving according to a proper

Line

Line, createth a peculiar *Radins*: so that the whole Air, encircled within the Membranes of the Drum, is moved in several lines, and is as it were a Cylinder, made up of innumerable contiguous Rays; whence it may be inferred, That the Motion of the inclosed Air, (repelled from the higher to the lower Membrane of the Drum) seemeth to resemble that of the innate Air, lodged within the upper Tunicle of the *Tympanum*, and the lower of the *Coclea*, of which the inward is beaten back to the *Coclea*, wherein it affecteth the auditory Nerve.

The Compage of the innate Air (as I conjecture) is made up of many *Radioli*, moving in a Pyramidal Figure, whose Base is near the *Tympanum*, and its point (wherein the fine Rays are united) is placed about the *Fenestra Ovalis*, through which they pass into the *Labarintus*, and from thence they are transmitted through the *Fenestra rotunda*, in order to make Appulses upon the spiral Flexures of the *Coclea*, clothed with a fine nervous Tunicle, the proper Sensory of Hearing.

Some are of an Opinion that the *Radii* of the external Air, do not propagate new ones in the innate Air, but the minute configured parts of the outward Air, do insinuate themselves through the Pores of the Membrane belonging to the *Tympanum*, and do configure the contiguous Particles of the innate Air, and so one after another, till at last the moved Particles do affect the auditory Nerves, besetting the Tunicle of the *Coclea*. And this conjecture they endeavour to explain by the trajection of Rays of Light through Glas; which instance seemeth not to be satisfactory, because the Rays of Light, are much more subtle then those of ambient Air, whose Particles, if they could penetrate the Pores of the Membrane of the *Tympanum*, by the same reason the minute Bodies of the more pure and thin innate Air, would soon quit their confinement, and transpire into, and embody with the contiguous outward Air: whereupon the inward Recesses of the Ear would be left destitute of innate Air, which is generally believed to be the immediate medium of Hearing. But farther, say they, That Sounds being very many small bodies of Air diversly moulded, and by reason of their several Figures, various kinds of Sounds are formed; therefore how can the auditory Nerves be affected, to receive the impressions of various Figures of Air moving upon them, if the modelled Particles of external Air, do not permeate the Tunicle of the *Tympanum*: From this it might be argued as well, that the coat of the *Tympanum* is the Organ of Hearing, discerning the variety of Sounds, as the diversly modified Particles of Air do after different manners affect the Coat of the *Tympanum*. But I humbly conceive it more probable, that the said Membrane receiveth several Appulses from the different configured Particles of Air, contiguous to the outward surface of the Membrane of the *Tympanum*, which is thereupon diversly contracted and moved, and then this Contraction and Motion being imprinted upon the inward surface of the said Membrane, immediately forceth a retrograde Motion in the innate Air, and conformeth it into Rays (according to the first Model of the outward Air) making several strokes upon the auditory nervous Fibrils, branched through the Membrane enwrapping the *Coclea*; from whence it may be deduced with good reason, that the Membrane of the *Tympanum* cannot challenge to it self the attribute of being the Sensory of Hearing: And though the Tunicle of the *Tympanum* be not wholly destitute of Nerves (which are common to all Membranes) yet it is not furnished with branches of the auditory Nerves, and so is rather an instrument of Touching then Hearing.

Farthermore

Farthermore we may add this in opposition to the Hypothesis, in making this Membrane the prime seat of Hearing, by reason inward sounds are not formed solely by appulses of Air *ad extra*; as modelled upon the Coat of the *Tympanum*, but framed also by innate Air, configured within the *Tympanum*, in the inward Penetrals of the Ear, sometimes resembling the noise of running Waters, othertimes of a Drum, or of hissing, and the like, proceeding from gross, or more thin vapors, which taking their rise from within the Head, and passing through the *Meatus* of the Skull, do affect the innate Air, which is acted sometimes with uniform, othertimes with various, and a Third way with continued, or repeated Motions, which beating upon the auditory Nerves, derive their Birth from Vapours, arising out of neighbouring parts.

It seemeth also evident, that if the Ears be affected inwardly with Diseases, that the *Bombus internus Aurium*, is silenced by a vehement outward noise of the Membrane of the *Tympanum*, which is effected (as I conceive) by the faint inward motion of the innate Air, ceasing upon a new more vigorous motion super-induced, which quieteth, or at least confounds, or obscures the other by over-powring it. The innate undulating Air, as new *Radii* are formed in it, is conformed to the more lively configurations of the external Air; First imprinted upon the outside of the *Tunicle* of the *Tympanum*, and then the inside being contracted, the same impressions are made upon the innate Air, and afterward are transmitted to the Membrane (covering the *Coclea*) interspersed with many nervous Fibrils.

C H A P.

C H A P. XIX.

Of the Diseases of the Ear, and its Cures.

THE Ear is a rare Compage, made up of an outward Expansion, endued with divers Flexures, and a more inward passage, and many little Bones, Muscles, Membranes, Holes, and Meanders, beset with nervous Fibrils the immediate Organ of Hearing, which is disordered with greater and less disaffections of the auditory Instruments, productive of a lessened or abolished Function, which is caused either originally by some defect of the Brain, or by default of the Ear.

A diminished, or lost Hearing may proceed either from a cold and moist distemper of the Brain, or by the Origen of the Nerves, obstructed in the ambient parts of the Brain by some gross Humor, lodged near the extremities of the Fibrils, or by some extravasated Blood or Recrements, compressing the beginning of the Nerves, hindring the current of the animal Liquor and Spirits, into the auditory Nerves, which happeneth in an Apoplexy, and other sleepy Diseases, which are cured by bleeding, Purging, cephalick Julapes, Powders, Pills, of which I intend to treat of more at large hereafter in the *Therapeuticks* belonging to the Diseases of the Brain.

The causes of a lessened or abolished Hearing.

The disaffections of Hearing are derived also from defect of the Ear, either when the auditory passage is obstructed by Recrements, or gross Humors, or by any Tumor, Abscess, purulent Matter, &c. hindring the free reception of Sounds into the inward recesses of the Ear; whereupon they cannot make brisk appulses upon the auditory Nerves, whence proceedeth a dulness of Hearing.

The obstruction of the auditory passage.

This Disease is often cured by injections of *Canary Sack*, and other cleansing Decoctions of a healing nature; as also Fomentations may be applied to the Ear, made of Centaury the less, Marjoram, Rue, Bays, and with the Flowers of Chamæmel, Melilot, Rosemary, Lavender, Mace, and Cinnamon boiled in equal parts of Water, and White wine added in the end of the Decoction, out of which may be made a *Suffitus*, received by a Tunnel into the entrance of the Ear, which is conducive to the cure of the lessened or lost Hearing, as the warm vapors of the Decoction do penetrate into the inward parts of the Ear, and relieve the *Tympanum*, and its Muscles and Nerves, besetting the *Coclea*. Instead of a Fomentation may be immitted into the auditory passage, hot Bread (prepared with Seeds of Caraway) newly taken out of the Oven, and moistned with new Balme, made warm.

The cure of the obstructed auditory passage.

After a Fomentation, Injection or Fume have been admitted, a little Cotton or Wooll may be put into the Ear, mixed with Civet, and some drops of the juyce of a roasted Onyon, or Oil of bitter Almonds, Rue, or the like.

Sometimes the hearing is impaired by relaxation of the *Tympanum*, produced by a cold and moist distemper; or when the *Tympanum* is not rendered Tense, by reason the outward and the inward Muscle are so weakened, that they cannot contract themselves, and brace the Drum of the Ear, to give a reception to the appulses of Sounds embodied with Air.

The disaffection of Hearing caused by a relaxed *Tympanum*.

The thickness
of the Tym-
panum.

Othertimes the *Tympanum* groweth thick, as incrassated with gross Recrements, or by an unnaturl thick substance, or by a double Membrane, which hath been observed in some persons.

Little Insects are bred sometimes in the Cavity of the Ear, which give a great trouble in their constant motion, making a high discomposure and noise in the Ear; These minute Animals are killed by the injection of bitter Medicines, as juyce of Wormwood, or Centaury the less into the Ear.

The Hearing
is vitiated by
noises within
the Ear.

The sense of Hearing is depraved by the noise of the Ear; and as the Eye the Organ of Sight, ought to be destitute of all Colour, that it may duely perceive variety of Colours as its proper Object; (Whereupon an Icteric Eye, prepossessed with Yellow, spoileth the Sight) so unkindly Sounds lodged in the Ear, do hinder the perception of external Sounds, and deprave the Sense of Hearing.

The causes of
a sound in the
Ear.

A Sound ariseth in the Ear by the violent motion of the innate Air, which is gently moved when the Object is duely discerned by the influence of Sounds embodied with Air, making soft appulses upon the *Tympanum*; And the implanted Air is more vehemently moved by some unnatural cause, which (as I humbly conceive) are Vapours and Wind, which being endued with an Elastick disposition, do strongly agitate the inward Air of the Ear, and produce unnatural Sounds in the Ear, disturbing the auditory Fibrils, which may come from a vaporous mass of Blood, transmitted by the corotide Artery to the instrument of Hearing, which is very frequent in Hypochondriacal and Hysterick indispositions of Body.

This disaffection may also proceed from a purulent, or sanious Matter, and from pituitous Recrements, out of which Vapours may arise, giving a disturbance to the motion of the inward Air.

Variety of unnatural Sounds, are produced by the multitude or paucity, by the thinness or grossness, or by the Stone, or violent motion of Vapours; if they be crass, and moved with a turbulent stream they seem to resemble the noise of rapid torrent of Water, if the vapours be thin and be moved with quickness, they make a hissing noise, so that the greater or less proportion, or more or less thinness, or grossness, and the violence or slowness of motion of Vapours, are productive of variety of Sounds, disaffecting the Organ of Hearing.

The cures of
the noises,
proceeding
from a hot and
vaporous mass
of Blood.

If this Disease be derived from a hot and spirituous indisposition of the Blood, disaffecting the Ear, it denoteth cooling and moistning Decoctions prepared with Barley, Violets, Lettice, Water Lillies, Seeds of Melons, Pumpions, White Poppy, &c.

If it taketh its rise from gross and numerous Vapours, after purging evacuations have been celebrated, attenuating and descutient Medicines (recited before) may be applyed to the Ear, by way of Fomentation, Suffumigation; as also a little of the Decoction of Millepedes, in Water and Wine, may be administered with a Sponge; and Medicines composed of the Galls of a Pike, prove very efficacious in the cure of this Disease.

Decoctions of Calamint, Majoram, Centaury the less, Granes of Juniper, Bay-berries, and Worms, washed in White-wine, and tied up in a rag, are proper in this case, used by way of Fume or Bathing, in reference to the noise of the Ear.

The inflam-
mation of the
Ear.

The Ear is also afflicted with more troublesome Diseases of an Inflammation and Ulcer; The First is known by a violent beating pain, a great heat, and redness of the Ear, which is extended sometimes to the Cheeks and Temples.

An

An Inflammation borroweth its rise from a quantity of Blood, brought by carotide Artery, either into the substance of the outward Auricle, or into the *Tympanum*, or other Membranes, (lodged in the inward Cavity of the Ear) into which so large a quantity of Blood is imported by the terminations of the carotide Artery, that the Purple Liquor cannot be received into the small Extremities of the jugular Veins, which is produced either by the plenty, or grossness of the Blood, loosing its motion in the Interstices of the Vessels; whereupon it ferments and acquireth an Inflammatory indisposition, giving a great pain to the nervous and membranous parts of the outward and inward Ear, accompanied with a troublesome pulsation of the Arteries, caused by the intercepted motion of the Blood, in the substance of the Ear, compressing the Artery, and hindring its free pulsation, which is also produced by a vehement motion of the Arteries, labouring to make good the hindered circulation of the Blood.

As to the cure of this Inflammation, a Clyster being premised, a Vein is to be opened in the Neck or Arm; and if the Disease be very high, accompanied with intolerable pains, a temporal Artery may be opened, and Cupping-glasses applied to the Shoulders and Neck; and after gentle Purgations have been used, Topicks may be applied and a Fomentation made up of the Leaves of Mallows, Violets, the Seeds of Quinces, and Mallows, of the Flowers of Elder, Chamamel, Melilot, and Red Roses.

Afterward a Cataplasme may be administred, prepared with Chickweed, *Lenticula palustris*, boiled in Milk, and made into a due consistence with crums of White Bread.

And roasted Onions mixed with Oil of Elder, or Roses, and a little Saffron may be applied to the Ear, in the form of a Pultice, warm.

Womans new Milk, beaten up with the White of an Egg, may be put into the Ear warm, with some Wooll or Cotton: As also Oil of Water-Lillies, or Roses, mixed with some drops of juyce of Night-shade; or Plantain may be used after the same manner.

Inflammations of the Ear (coming from a quantity of Blood) stagnating in the Interstices of the Vessels, lodge in the coats of the Ears, often degenerate into an Ulcer, as the serous Particles of the extravasated Blood, being not discharged by Bleeding, Diaphoretick and discutient Medicines, do acquire a putrid Nature, and corrode the Filaments of the auditory Membrane, through which they employ themselves into the Cavity of the Ear.

Ulcers of the Ear are also produced by sharp saline Recrements, transmitted with the Blood, by the extremities of the carotide Arteries, into the substance of the Membranes; whereupon they grow exulcerated, by the acrimony of the serous saline parts of the Blood.

In this Disease, afflicting a Plethorick, and Cachochymick habit of Body, Bleeding and Purging may be advised, and then Topicks may be applied, made of cleansing and healing Medicinss, as Wine, in which Flowers of Red Roses have been boiled; as also the juyces of Beets, Horehound, and Honey have been boiled together, and mixed with Syrup of dried Roses, with which afterward a little of the Gall of a Pike, Lamb, or Calfe, may be mixed.

Frankincense and Honey, or a little White-wine, or Vinegar, may be boiled together, and some drops may be applied to the inside of the Ear with Wooll or Cotton.

The Head
may be called
the Palace of
Virtue and
Science.
The entrance
of the Head.

The Dura and
A temporal
Artery may
be opened in
the said In-
flammation.

The Cure
of the
Inflammation
of the Ear.

The Cure
of the
Inflammation
of the Ear.

The Cure
of the
Inflammation
of the Ear.

An Ulcer fol-
lowing an In-
flammation of
the Ear.

Ulcers flow-
ing from
acrimonious
Humors.

The Cure of
the said Ul-
cer.

The Cure
of the
Inflammation
of the Ear.

The Cure
of the
Inflammation
of the Ear.

C H A P. XX.

Of the Hair.

The Head
may be called
the Palace of
Virtue and
Science.
The enclosure
of the Head.

THE highest story relating to the elegant structure of Man's Body, (commonly called the Head) may be well styled a Palace of Virtue, and Science, in which the Soul, as a Queen, performeth her most noble acts.

The Head being the Presence Chamber of the Soul, is immured with the Skull, as with a thick Wall, outwardly cased with many thinner enclosures, The Hair, *Cuticula*, *Cutis*, *Membrana carnosae*, *Pericranium* & *Periostium*.

The *Dura* and
Pia meninx are
the Hangings
of the Brain.

This choice apartment is furnished within with Two fine Hangings of the *Dura* and *Pia mater* (clothing the Cortex of the Brain,) curiously carved into many *Anfractus*, running in several Meanders, curiously embroidered with great variety of Vessels, shading the covering of the Brain, and resembling a fair Landscip, drawn by a Divine Hand.

The *Cerebrum*, and *Cerebellum* are
the inward
parts of the
Head.

The Guests Lodging in this noble *Palladium*, are the most excellent part of Man's Body, the *Cerebrum* and *Cerebellum*, giving Sense and Motion by subtle irradiations; by which the Soul celebrateth her Divine Functions, and taketh care and conduct of this lesser World.

The Hair is
the most out-
ward cover-
ing of the
Head.

My Province at this time being the Head, I will present you at first with the most outward covering, the Hair, which may seem to deserve our notice, as it consisteth of many oblong Bodies, made up of Filaments, rooted in the Skin, and growing out of the pores of the Body.

The Antients
conceived the
Hair to be
formed of
Steams.

The antient Philosophers assign this manner and method of the production of the Hair: The gross steams of excrementitious Matter arising from the Third Concoction in the habit of the Body, are carried upward, till as troublesome Guests, they are forced outward to the pores of the Skin, where sticking some time in the narrow passages, they are concreted, till a new access of steams do croud one another forward, and generate Hair (as they will have it by apposition) and propagateth in length, by a constant new accretion of Matter; but this scruple may be started (which seemeth to oppose this Hypothesis) That if Hair doth proceed from the Vapours of excrementitious Matter, which universally transpire through the pores of the whole Body, why is it not generated in all parts of the Skin? which if true, would disguise the beautiful colour of the surface of the Body.

Farthermore, I do not conceive it reasonable that Hair should be produced and nourished by apposition of concreted Vapours, impelling one part after another forward through the Pores of the Skin, which if granted, Hair when cut, must remain obtuse in its extremity, as when it is first cut; But on the contrary, their ends change their Figure they obtain in Barbing, as their Extremities grow from obtuse to acute.

Hair is not
generated per
appositionem sed
per *intus sus-*
sceptionem
alimenti.

Wherefore I most humbly conceive, that Hair is not generated by apposition, but by a nutritious juyce proper for Hair, which first produceth the Roots, which being porous, receive the alimentary Liquor into their substance, and doth increase chiefly in length, *Non per appositionem, sed per intus susceptionem alimenti*, whereby it is augmented after the same manner as other parts of the Body are increased; so that Hair is not only enlarged in its dimension of highth, but greatness too, as is most conspicuous in the Hair of

Hair is in-
creased in va-
rious Dimen-
sions.

of the Head and Beard (caused by frequent cutting and razing) which is smaller in Infancy and Childhood, and groweth bigger in more mature years.

The first pro-
duction of
Hair.

It is very probable that Hair is generated in the *Uterus* out of the more gross Particles of seminal Matter, or rather out of Liquor distilling out of the extremities of the Nerves, and albuminous Matter coming out of the terminations of the Arteries, inserted into the substance of the cutaneous Glands, wherein the Roots and Origen of Hair are generated out of nutritious Liquor, disposed with peculiar qualities fit for productions of the first rudiments of Hair, formed in the Interstices of the Vessels belonging to the Skin, where the Aliment is first communicated to the Roots, and afterward by Pores to the whole Body of the Hair, after the manner and production and increase of Plants, which receive nourishment, first out of the bowels of the Earth by Roots, which afterward from thence is communicated to the stem or trunk, and then to all parts of the Plants.

As to the Figure of the Hair, it is most commonly straight and pendulous toward the Base of the Head, and is sometimes naturally crisped and curled, as in *Æthiopians* proceeding from their hot and dry Constitution; but the *Scythians* are endued with Plane, long Hair, which *Aristotle* saith is derived from moisture, and straight Hair from straight Pores of the Skin, crisped and curled from crooked: And though Hair may seem at the first view to be solid and round, yet upon better inspection, some Hair appeareth Triangular, others Quadrangular, and a Third round, by the help of Glasses, when the Hair is cut into small Particles, and viewed with a curious Eye.

The Figure of
Hair.

The colour of the Hair, according to our great Master *Hipocrates*, proceedeth from variety of Humors, entring into the Skin, in which the Hair is implanted, as the Author hath it in his Book *De Natura Pueri*, *Ὁ νόστος ἀντὶ τῆς οὐδὲς ἰσχυρὰ ἐλκεν, ἢν τε λευκὴ, ἢν τε πορφυρὰ, ἢν τε μέλαινα, πικρὴν πλὴν χροῖον καὶ ἢ σπῆξ ἴσχυει.* Whatsoever Humor passeth into the Skin, whether it be White, Yellow, or Black, the Hair is to be affected with that colour, so that according to this Hypothesis, the colour of the Hair is derived from the Humors, with which it is nourished in the Skin; And in pituitous cold temperaments, the Hair is White, in Cholerick Yellowish, in Melancholy, flowing from adust Humors, it is Black, and in mixed Constitutions, produced by diverse Humors, proceed the other intermedial colours of Hair. The *Indians*, *Egyptians*, *Arabians*, *Spaniards*, are furnished with Black Hair, as living in hot Climats, and from indulging themselves with Wine for their ordinary Drink, and from eating Salt Meats. And the *Germans*, *Low Dutch*, *English*, *Swedes*, *Danes*, &c. have Red and brighter Hair, as leading their lives in cooler Climats, and more temperate Drink of small Beer, Ale, and as having more generally, pituitous constitutions of Body, then those that live in hot Countreys, where the beams of the Sun are more predominant: According to this Hypothesis, an Inference may be made, how the great variety and change of the colour of Hair is produced; which may very much alter in the same person, as the Temperament and Humors are varied: Of which *Macellus Donatus* giveth a remarkable Instance in his History *De Medicina mirabili*, of a Senator whose Hair turned White in his declining Age; and afterward his Blood was mingled with copious Bile, which did not only deform his Skin, with a Tawney hue, but tinged his Hair too with a Yellowish colour, somewhat inclining to a Green.

The Colour
of Hair.

Learned *Tardinus* deduceth all intermedial Colours from an equal, or a greater or less portion of White, mingled with Black. The dark colours

do participate a greater share of Black, and the more Light are tinged with a larger proportion of White, and Green, by being as it is conceived, an exact intermedial colour, hath equal degrees of the extreme Colours, as being not over-much deepned by Black, nor hightned with White; but equally hued with each of them.

Some do derive the Colours of Hair from Lights and Shadows.

Others, and those of great Learning too, do fetch the colours of Bodies from diverse degrees of Lights and Shadows, by reason all Bodies are affected with more or less unevennesses; whereupon they are receptive of more or less Shades, and Lights, so that Bodies deepned with dark colours, have larger Cavities, making greater Shades, and those that are hightned with bright colours, admit greater degrees, as having their Surfaces more plane, and being endued with less Cavities.

Hair may seem to receive the tincture of White and Black, as it is acted with diverse modellings of Light, so that White hath greater reflections of Light, and Black is as it were dulled, as having fewer Rays of Light; and the intermedial colours, are not made by reflection, as White and Black, but a kind of Refraction, in which the beams of Light are rendred somewhat oblique, when they are darted from an opaque Body, and do not rebound from them in right lines, as in the reflection of the Rays of Light.

The use of the Hair.

Hair is not made only for Ornament, but Use too, and seemeth to be a covering for the Skin in Man, as Feathers in Fowl, and Scales in Fish; and serveth for a defence to secure the Head, as well from the scorching Beams of the Sun, as from the too great allay of Heat, the importunate cold of stormy blasts of Wind, and severe Frosts.

Some have numbred Hair among the parts of the Body, which I deem somewhat improbable, seeing it is not an integral part, united to the Body by a common principle of Life, but hath a proper principle of Vegetation, resembling Moss, growing upon the Bark of a Tree (as Hair on a Human Skin) and participates a Principle, different from that of the living Tree, as having growth, and nourishment from the Tree, being dead, from a proper Juyce, communicated from it to the Moss; and after the same manner it fareth with Hair in a humane Body, which dispenseth nourishment and increase to Hair, as hath been often observed in dead Bodies.

The manner how Hair is nourished.

Some are of an opinion, that nourishment is administred to Hair by Apposition only, so that the Roots must be increased next the Skin, and according to their Sense, the alimentary Liquor is no ways received into the Pores relating to the Body of the Hair; whereupon, neither the Cavities nor Circumference can be enlarged; but the contrary may be made evident to the Eye, as the Hair of the Beard by often shaving, groweth not only in length but in greatness too, and increaseth according to all Dimensions.

So that I humbly conceive, the Hair hath secret *Meatus*, by which the nourishing Juyce may be transmitted from one extrem to the other, from the root to the termination of the Hair, which may be made good in the *Plica Polonica*, where in the intrangled Locks, the Blood distilleth out of the terminations of the Hair, which I apprehend is transmitted to the Hair; after this manner in a *Plica Polonica*, the Blood being acted with a high Ebullition, is impelled from the greater branches to the smaller capillaries, terminating into the cutaneous Glands, in whose Parenchyma the Blood being very thin, is conveyed through the Pores, dilated by heat into the roots of the Hair, and thence is protruded farther and farther by small Cavities, to the Extremities of the Hair; by the same reason the ferous Particles (being secerned in

in the cutaneous Glands from the more pure parts of the vital Liquor) may be received into the Extremities of the Hair, and be imparted by minute passages through the whole body of it ; whereupon it is receptive of growth and nourishment.

C H A P. XXI.

Of the Feathers of Birds.

THE Feathers of Birds, though they be different in structure, as consisting of variety of parts ; yet they hold some Analogy with the Hair of other Animals, as they are implanted into, and receive nourishment from the Skin (to which they are ministerial as a warm covering) and as they are in part made up of numerous small Filaments, somewhat resembling Hair.

Feathers hold
some Analogy
with Hair.

The Compage of Feathers is composed of various parts, the Quill, the Stem, and the Filaments adjoyning to it.

The different
parts of a
Quill.

The Quill of a Goose is a Tubular Body, somewhat round in its Origen, and depressed afterward on each side, and containeth in its Cavity, a fine Filme, or rather many Filmes ; and its outward frame being made of a horney substance, is not one entire Body, but composed of many thin flakes, so curiously conjoynd, that they seem but one substance.

The descripti-
on of a Quill.

The filamentous part, lodged in the horney Tube of Feathers, hath its Origen affixed to the beginning of the inside of the Quill, and terminateth into the first rise of the White Pith.

The Filamen-
tous parts of
a Quill.

As to the structure of the Filme, it is a rare Contexture, made up of a thin membranous substance, interspersed with many fine spun Filaments, very much alike to the wings of Insects.

The structure
of the Filme.

This fine light Body, seated in the inside of the Quill, is framed of many thin Tunicles (beset with diverse Fibrils) which are halfe way enwrapped one within another, and do resemble thin membranous Bladders, open on the top, and are close in their Origen, which is tied to a small stalk, running through all these vesicular Tunicles. The stalk (to which the many membranous Vesicles are conjoynd) is furnished with many small Arteries and Veins, derived from the Skin, which import vital Liquor into the Quill, Pith, and Filaments affixed to the Stem.

If any curious person doubt the truth of this Hypothesis, he may be satisfied if he will give himself the trouble to inspect unripe Feathers of a Goose, where Blood may be seen in their Origen, and if the Quill be opened, the Blood-vessels may be discerned to pass through the membranous Vesicles, toward the White Pith, and Downy collateral Branches, affixed to each side of the stem. This rare frame of the Quill hath a White curdly Pith, every way immured within a thin horny Shell, propagated from the Quill, with which it is one continued substance.

The Blood-
vessels of a
Quill.

The Pith of
a Quill.

The Stemm is adorned with a crooked pyramidal Figure, whose Base adjoyneth to the Quill, and its Cone is made in its termination.

The Figure of
the Stemm.

The

The Convex
surface of the
Stemm.
The Concave
surface of the
Stemm.
The upper
Margent of
the Stemm.
The inferior
Margent.

The oblong
broad Filaments.

The Fringes of
the Stemm.

The various
Colours of
Feathers.

The producti-
on of Colours
in Feathers.

The Stem is clothed with a Convex-surface in its upper Region, and with a Concave in its lower, through which a Fissure passeth all along from its Base to the Cone, dividing the inferior part of the Stem into equal parts.

The upper Margents of each side of the Stem, adjoining to the Concave-surface, are beset with Two ranks of Filaments, or Hairs, the higher are short and small, and the inferior somewhat larger and longer, and are both inserted in their Origens into the horny covering of the Stem.

These oblong broad Filaments have their Origens larger, and end into Cones; they are placed in great order, and for the most part nearly conjoyned to each other by a glutinous Matter; and if they be rendred somewhat disordered by violent motion of the wings in a great flight, they are easily reduced into order, as drawn between the upper and lower Beaks of Birds.

The Stem is not only beautified on each side with curious Fringes, framed of many fine downy Hairs, distinguished with numerous creces as so many partitions, but is rendred strong with a thin horney covering (incircling a White, Coagulated, Spungy Substance, making the Cavity of the Stem full and tight; so that it cannot be easily bent, when the Feathers are moved with great force in the flying of Birds.

And this white curdly Matter (stuffing up the hollownes of the Stem) conducteth the tender Vessels, in order to the nutrition of the neighbouring parts; and I humbly conceive, that these white, Spungy Particles, serve also as so many Glands to percolate the serous Liquor of the Blood from the Red Crassament, in reference to the nourishment of the various parts belonging to the Stemm.

The Feathers of several sorts of Birds are as it were painted with variety of Colours, which I humbly conceive are rather imaginary and apparent; then real and inherent, as being so many different models of Light, as it is sometime more or less deepned by greater or less shadows, produced by a company of diverse unevennesses, situated in the surfaces of Bodies.

And other times variety of colours are generated by a number of bright reflecting parts, which accompany minute Bodies (disposed in various Positions) whose Figure it is difficult to assign, by reason every new posture, made against the Light, seemeth to give these fine reflecting parts a different form, which is very pleasant to behold in a Microscope.

Variety of Colours also do owe their Origen to strong, and fainter Appulses of Light, made by oblique Rays, receiving different impressions by various Refractions, in the surfaces of diverse transparent Mediums, affected with several degrees of Density or rarity; whereupon greater or less refractions of Light are made, when the Rays are more or less easily transmitted through diverse thin diaphanous Bodies.

The Feathers adorning the Wings and Tails of Birds, are made up of many broad thin Filaments (seated two by two over against each other, as inserted into the higher Region of the horny Integument) and are Systems of innumerable thin Downy Flakes, conjoyned to each other; and the lower Region of these laminated Bodies, have a dark substance, not receptive of Light, but reflects its Rays to that side from whence they come, and seem much to resemble the foil of a Looking-Glass; but their upper sides appear to be made up of a number of fine Feathers, as so many plated Bodies, which are very thin, and lye very near together, like the Shells of Mother of Pearl (as ingenious Mr. Hook hath observed) which do not only reflect a very brisk Light, but tinge it also with divers fine Models, and by various positions, in reference to the Light, now and then one colour, and after-

ward

terward another is reflected, (as suffering various Refractions) through the Interstices of the Plates, filled with Air, acted with beams of Light, so that the fine spun Filaments of Feathers, adorned with bright reflecting Particles, must needs produce variety of glorious lively colours, as the rays of Light sport themselves in several postures in the Interstices of the flakes of Feathers, interspersed with the elastick Particles of Air.

This gay Apparel of Feathers, as died with variety of pleasant Colours, is not intended by Nature so much for Ornament as Use, which is to invest the tender Skin, to secure it against the importunate blasts of cold weather.

The First use
of Feathers.

The Second and more principal use of Feathers, is to render the Bodies of Birds light, in order to flying, to give the greater advantage to the elastick Particles of Air, to support their weight, and transfer them from place to place; which is accomplished by a Mechanisme of the wings (contrived by nature with wonderful Artifice) as Machines of Flying, and are framed of many articulated bones, of the *Scapula*, *Humerus*, *Cubite*, *Radius*, and *Carpus*, curiously disposed into Joynts, which being enwrapped one with in another, by Muscles called *Flexors*, do bring the wing into a small Model, and make it fit close to the Body, to give ease to Birds in their repose and freedom from flying.

The Second
use.

The wing is stretched and expanded by the Tensors, unfolding the several bones of the Pinion, and do fit it for flying, which is performed partly by the Elevators, or Abductors, lifting up the Wing after it is extended, and chiefly by the Depressors, or Adductors, the pectoral Muscles drawing it downwards, to give a brisk appulse upon the ambient Air, consisting of elastick Particles, which being compressed, do resist the motion of the wing.

The Wing is
extended and
expanded by
Tensors.

Birds being more ponderous then the Air, are supported by the aid of their extended and dilated wings, fastened to the bones of the *Scapula*, and *Humerus*, seated in the upper region of the body of Birds; whence it may be reasonably inferred, that the center of Gravity is lodged in the lower part of the Breast (before the Origins of the wings) wherein all parts of the body are equally poysed or ballanced in a right perpendicular line, passing to the Horizon, from the roots of the wings to the Cavity of the *Abdomen*, and middle of the bone of the Breast, with reference to the length of the Body, in which posture Birds make their Nests hanging upon the branches of Trees.

Birds are sup-
ported by Air.

The bodies of Birds hang in the Air according to an equal ballance of all parts, through whose middle a right line being drawn perpendicularly to the Horizon, is called the Center of Gravity, in which posture Birds being placed in a fluid Medium, kept from falling downward, as boyed up by a light Compage of Feathers, dressing the Body and wings of Birds, being expanded, which are first lifted up by the Muscles, called *Elevators*, and afterward impetuously drawn downward by the pectoral Muscles; whereupon the dilated wings do make strong appulses upon the Air, not in one part, but according to the dimensions of breadth and length of the whole wings, whose strokes are made according to circular circumferences, agreeing in proportion, and arise from the Center to the Extremity of the wing, whose appulses are encountred by the Concave-Surface of the Air, briskly fanned into a thickness, and re-acting (as compressed by the strokes of the wings) and darting the light Compage of Birds forward, as the elastick Particles of Air do strongly press upon the under and hinder Region of the body of Birds, pushing them forward in flight, as their Gravity is countermanded by a strong resistance of the active, expansive Particles of Air.

The Bodies
of Birds are
equally poise-
d.

The Center
of Gravity.

The various
motions of
the Wings of
Birds.

The manner
of Flying.

To conclude this Subject, I humbly conceive the manner of Flying is performed after this manner, Birds being dressed in their bodies with a light covering of numerous Feathers, and in their wings with various ranks of greater and less Quills, fringed with innumerable Downy or Hairy Filaments, First begin their Flight from the ground by bending their Thighs, and making a leap from the *Area*, on which they rested, and then expand their wings, by bringing them to a right Line, if perpendicularly considered, in reference to the lateral Surface of the Breast (as Learned *Bonther* will have it) so that the wings being extended in a strait posture, do run transversely over the length of the Body in the manner of a Cross; so that their dilated wings being elevated above the Horizon, do make strong vibrations upon the Air, received into the hollow surface of their lower Region; whereupon the compressed Air being of an expansive Nature, doth resist the weight of the Bird, and by its elastick Particles, crouding upon the hinder and lower part of its Body, doth carry it forward by a kind of even swimming motion, through a fluid Medium.

CHAP.

C H A P. XXI.

Of the Scales of Fish.

Fish have their Skin covered with Scales (as that of Man's Head, and the Bodies of Beasts with Hair, and Birds with Feathers) adorned with several Colours, Figures, and Magnitudes; These numerous fine Integuments, beautifying the Bodies of Fish, are curiously set together in elegant Order, and most decent Figure.

I will begin with the Scales of a Carp (as very eminent in structure) and treat of their Situation, Connexion, Figure, Magnitude, Colour, Substance, and Use.

Their Situation (in this as well as other Fish) is very remarkable, as they are placed one over another after the manner of Slates upon a House, † and their Origenes are inserted into the *Parenchyma* of the Skin, where they stick fast, and are also connected to each other, by the interposition of a glutinous substance; and seem to have Black lines garnishing their Margents, (where they are naturally conjoyned in their circumferences on the sides) and have their out-lines Latified with White upon the Belly.

The Figure of these Scales seemeth somewhat to resemble that of a Scolop, † as being endued with smaller Dimensions in their beginning (where they outwardly appear) and larger in their termination; Or they may seem not to be altogether unlike Lozenges, as furnished with various Angles.

As to the dimensions of these Scales, they are much different in Magnitude, of which the least are seated near the Back and Belly, and the largest upon the sides of the Fish; and are all both small and great, endued with the same Figure.

They have variety of Colours, as they are yellowish on the sides, and in the middle, and brownish in their Extremities, where they are mutually usually fastned, making a kind of Checker-work; and on the Belly the Scales are beautified in the middle with a kind of shining Pearl colour, and have their edges brightned with White, where their Margents are affixed to each other.

The substance of these Scales is firm and solid, as they are a Compag, made up of many Cartilaginous Fibres or Filaments † closely put together, and are more nearly seated in their Origen, and diffuse themselves like so many Rays through the Surface of the circumference.

Every Scale of this Fish seemeth to be formed of Four triangles † (which is pleasant to behold) a Superior, Inferior, and Two lateral ones, whose Bases are placed in the circumference, and their points all concenter in the middle: The Superior and Inferior Triangles are streaked with lines, running in length, and the lateral Triangles have their filaments running transversly; and all the Fibres of each Triangle have their lines more close in their Origen, beginning as it were in a point, or in an Angle, and then are displayed toward the Base of every Triangle.

All the Triangles of a Scale in this Fish are arayed with a whitish colour, except toward the termination or middle, where they are coated with a bright Yellow, or Pearl colour, as covered with a clammy Membrane of that hue.

The

The Skin of Fish are invested with Scales.

The situation of the Scales.
† T. 60. F. 3.
a a a a.

The Figure of the Scales.
† T. 60. F. 3.
b b b b.

The Magnitude of Scales.

The colours of Scales.

The substance of Scales.
† T. 60. F. 4.
a a a a.

The Scales formed of Four Triangles.
† T. 60. F. 4.
b b b b.

The use of
Scales.

The use of these Scales in this, as well as other Fish, is to preserve the tender Skin, and more fine inward part from bruises, when they encounter hard Bodies, which else would much offend them.

The Scales of
a Roch.

The Scales of a Roch have much affinity with those of a Carp in their Figure, Connexion, Situation, and Substance, as consisting of many cartilaginous Fibres, which make Plexes in the center of the Scales, somewhat resembling a Rose.

The colour of
the Scales.

Their colour is different from that of a Carp, as it is not Yellow, somewhat like Gold, but White and shining, after the manner of Silver on the sides of a Roch, and are endued with a bright yellowish colour on the Belly.

The Fibres in diverse Scales of this Fish, do come from the center to the circumference, and do much resemble the Rays of a Star, as held up against the Light; and are not so numerous as those of a Carp.

The Scales appear outwardly above in narrow Origenes, and grow more enlarged downward, somewhat like Scolops in Figure, and have their Surface varnished, with a shining, whitish clammy Matter; and do terminate into uneven jagged edges.

This Fish hath a ridge running down the middle of each side, in a kind of a line, as the Scales are directly placed one under another, bespotted with Black in the middle.

The Scales of
a Bream.

A Bream as well as other Fish hath diverse ranks of Scales, passing downward on each side the whole length of the Body, from Head to Tail.

The Scales are more closely placed one under another in this Fish, then in a Carp or Roch, &c. And are Systemes composed of numerous small, oblong cartilaginous Filaments, of which some make their progress in length, and others cross-ways; and their surface is adorned with four Triangles (as it found in Carps) which is pleasant to behold, as having their Origenes placed in the middle, and terminations in the circumference; and every Scale is a contexture, made up of many cartilaginous Filaments, curiously adapted, and firmly fastned to each other.

The Scales of
a large Gar-
fish.

† T. 60. F. 2.
a a a a.

The Scales of a large Garfish taken about the coast of *Virginia*, hath diverse ranks, of which the middle one † (running down the Back in a straight line) is dressed with various Figures, some are (as it were) of a circular, and others of an irregular Figure, hard to be described.

† T. 60. F. 2.
b b b b.

Of the lateral ranks of Scales, † some resemble *Romboids*, others *Triangles*, and others are endued with irregular Figures, and these lateral rowes, make their progress on each side of the right rank (seated in the middle) in Bevil Lines toward the Belly.

† T. 60. F. 2.
c c c c c.

The Scales of this Fish as well as others, are garnished with many streaks, or Cartilaginous Fibres † sporting themselves in variety of postures, upward, downward, and laterally.

C H A P. XXIII.

Of the Hair of Insects.

INsects have a kind of Down or Hair, which are the sportings of Nature, sprouting out of the Pores of the Skin; so that the whole Surface of the Head and Body of Silk-worms is adorned with fine Hair (set in wonderful order, especially about their Thighs) hued with a bright colour, and are more numerous then those of the Belly or Back, beset with divers Blue spots, encircling the roots of the Hair: The rings also encompassing the Body, are engraven with many Cavities, beautified with transparent Down.

The Bodies of
Silk-worms
are covered
with Down.

These also are adorned with a curious covering of Hair; And the Face of a Blew Fly is beset with tapering Black Hairs, which are seated on each side in pleasant ranks, bending toward each other in their tops, thereby making a kind of arched Bower, shading the Surface of the Front: And the Thorax, the middle Apartment is guarded with a kind of cartilaginous substance, as with a suit of Armor, whose ambient parts are garnished all over, with Brisles of a Conical Figure whose ends do point backward, as Mr. *Hook* hath well discovered.

Flies are covered with Hair.

And a Water-Knat hath a Head encircled with a Shell, and is beset in several places with tufts of Hair, seated in an admirable order; and the Belly of this Insect hath diverse Apartments, ending on each side in points, dressed with small tufts of Hair, very grateful to behold.

Water-Knats
are beset with
tufts of Hair.

And another fine Insect (which may be styled from its colour, a Silver Moth) hath Two pair of White Wings, placed on each side of the Head, of which the Anterior surpass the other in length, and both resemble a Fann, curiously bedecked with small Feathers, or adorned on each side with Fringes of White small Hair; and all the Body of this beautiful Animal is dressed above and below, with a kind of thin Feathers or Down, which may easily be parted from the Body, sticking to the Hand upon the least Touch.

The Body of
a Silver Moth
is dressed
with thin Fea-
thers or
Down.

Spiders also are curious Insects, invested for the most part with a Tegument of short Hair. The long-legged, or Shepherds Spiders are cased with a variegated Shell, encompassing its Thorax, all bespotted with long Black specks, which are so many shades of short Black Feathers, or Hairs (sprouting out of the thin Skull) enwrapping its long, small, and many joynted Legs, the supporters of its light Body, and the curious Machines of progressive Motion.

Spiders are
covered with
short Hair.

And no less admirable then the other is the Hunting Spider, so called, from ensnaring its prey in a Net finely woven, and originally drawn out of its own Bowels: This subtle Insect lieth lurking in some secret corner, and afterward skippeth out of its Den with nimble motion, to set upon Flies, surprized and caught in a fine undiscovered Web.

The Hunting
Spider.

These round little Animals are bespecked with dark coloured spots, with which the wings of Butterflies are bestudded.

The Pismire is a pretty brisk Insect, always in action, its Head and Thorax seem to be adorned with Black spots, which I conceive to be tufts of Hair; and its Body is armed with a kind of dark Shell, all bespangled with bright shining Bristles; and its Head, Horn, and Legs, and middle part of the Body, are bestuck with Hair, as it is well observed by Learned Mr. Hook.

Wandering
Mites are be-
set with light
Hair.

Black or wandering Mites have their Bodies armed with many Arrows next Oval Shells, engraven with variety of Cavities, beset with bright Hair (all pointing backwards) which giveth a Lustre to this industrious Animal, whose Head tapoureth into a Snout, parted with a Seam, running all along the middle of it, and is endued on each side with numerous Hairs, tending forwards.

The Legs of
Crab-like In-
sects are covered
with
Bristles.

The Crab-like Insect is scoloped with many minute Shells, and furnished with Legs, like those of Crabs, consisting of many joynts, covered on each side with fruitful Bristles, with which also small Cheese Mites are beset, growing out of Shells casing their Bodies, as with Suits of Armor.

CHAP.

And no less admirable than the other is the Hunting Spider, so called from explaining its prey in a Net finely woven, and originally drawn out of its own Bowels: This subtle Insect licks in some secret corner, and afterward skipeth out of a Den with nimble motion, to set upon Flies, lizards and caught in a fine undiluted Web.

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C H A P. XXIV.

Of the Pericranium.

THE *Pericranium* hath its lodging between the *Membrana Carnosa*, and the *Periostium*, and is a Membrane, encircling all the bones of the *Cranium*, and investing the temporal Muscle to the *Ossa Jugalìa*, and is a Coat distinct from the proper Membranes of the said Muscles (ending near the *Ossa Jugalìa*) And their proper Coats (being their Tendons,) do accompany them under the *Ossa Jugalìa*, to their insertions, into the acute Processes of the lower Mandibles.

The situation
of the *Peri-*
cranium.

The *Pericranium*, according to *Westlingius*, *Fallopius*, and other Anatomists, consisteth of a double Coat, the one adjoyneth to the *Membrana Carnosa*, and the other to the Skull, by reason these Learned Men make the *Periostium* (the proper Tunicle of the Skull) to be one of the Coats of the *Pericranium*; which deriveth its Origen from the *Dura Menynx*, it being (as I conceive) an elongation of it, and as passing through the Sutures of the Skull, expandeth it self all over the *Periostium*, which is most evident in Infants, before the bones of the Skull are closed; so that the *Pericranium* being naturally united to the *Dura Menynx*, upon the top of the Head, in the first production of the Bones of the Skull, but afterward when they arrive at greater maturity, and the Sutures are indented, and received within each others embraces, the *Dura Mater* is much nipped, and severed from the *Pericranium*, and preserveth its Connexion with it, only by Fibres, by whose interposition they hold an intimate correspondence with each other.

Some think
the *Pericra-*
nium to be
composed of a
double Coat.

The *Pericranium* is continued above on the top of the Head, to the *Dura Menynx*, and below to the Skull; and in the upper part of the Neck, to the common Membrane, relating to the Muscles, which is a membranous Expansion, derived from the *Dura Mater*, by the mediation of the *Pericranium*, and thence dispersed as a common Vest clothing the Muscles of the whole Body, and particularly the *Fascia Lata*, to which it is so closely fastened, that it is difficult to separate it from the Coats of that thin Muscle; but the common Integument of the Muscles descending a little to the Leg, is easily parted from the proper Coats of the Muscles.

The *Pericranium* is furnished with variety of Blood-vessels, Arteries from the external Carotides, and Veins from the outward Jugulars, some of which creep through small holes of the Skull, and inosculate with the internal Jugulars, which have recourse to the Third Sinus; whence the Blood is discharged out of the *Pericranium* by the external Jugulars, into the great Sinus; wherupon the *Pericranium* being inflamed, the Brain it self is drawn into consent by the external course of the Blood, transmitted from the *Pericranium* by the external Jugulars, passing through the small cranies of the Skull, into the *Dura Mater*, and ending into the Third Sinus of the Brain.

The Blood-
vessels of the
Pericranium.

The *Pericranium* hath Nerves, from the Third pair of the Brain, issuing from thence through the cranies of the Forehead into the *Pericranium*, which hath also other Nerves from those of the First and Second conjugation of the Neck, and from thence being reflected about the hinder part of the Head, do distribute many small Fibres into several parts of the *Pericranium*, rendring it

The Nerves
of the *Peri-*
cranium.

The *Pericranium* is highly sensible, as a contexture of Nerves.

it most acutely sensible: And therefore great care must be taken in wounds of the Head, (left except when upon great occasions of Fissures and Fractures, the Skull must be laid bare) that we hurt not the *Pericranium*, a contexture of many Nerves; whereupon violent pains of the Head, and other grievous Symptoms often supervene: and an Inflammation of the *Pericranium* is readily derived to the *Dura Mater* and Brain, by the intercourse of Fibres, by which they highly correspond with each other; Hence great wounds and Contusions of the temporal Muscles prove fatal, in reference to the *Pericranium*, with which for the most part they are invested.

The situation of the *Periostium*.

The *Periostium* adjoyneth to the *Pericranium*, (as having much affinity, as well in Nature as Situation) and is affixed to it in its upper Region, and hath its Concave-Surface fastened by many small Ligaments to the Convex of the *Cranium*.

This thin Expansion is a fine Tunicle, as being a rare Contexture, made up of many nervous and membranous Filaments finely spun, and curiously interwoven, so that their Commissures are so closely conjoined, that they cannot be discerned by a most quick Eye, and seem to be one entire substance.

The *Cranium* seemeth to be sensible in most acute manner, by reason of this curious Membrane (encircling it) as furnished with many small nervous Fibrils.

The Blood-vessels of the *Periostium*.

The *Periostium* as well as the *Pericranium* is endued with many small Branches of Blood-vessels, Arteries from the external Carotides, and Veins from the outward Jugulars, which import and export vital Liquor, to and from the medullary substances of the *Cranium*, and hath Nerves derived to it from the *Pericranium*, which is affected with Nerves, transmitted from the Third pair of the Brain, and from the First and Second conjugation of the Neck.

The Nerves of it.

CHAP.

C H A P. XXVI.

Of the Skull.

I Conceive it Methodical first to give you a Narrative of the Origin of the Skull, and of its Sutures and *Lamina*, and *Meditullium*, and afterward I will speak more distinctly of its lesser parts.

And it seemeth not unworthy our Consideration, that the Skull in an *Em-*
bryo in its first and ruder draught is Membranous, being formed of the more viscid part of the Seminal Liquor passing to the ambient parts of the rudiment of the Brain, and after the thinner and more watry parts being breathed out, the membranous parts of the Skull grow more solid, and turn Cartilaginous, and at last greater and greater Evaporations being made, the saline and earthy Particles grow more predominant, and the gristly compage of the Brain-Pan is turned bony, which is very tender in its first production, but afterward by the accession of new saline and earthy Particles, and the aqueous parts of the new formed Skull being continually evaporated, the Concretion groweth by intermedial steps more hard and solid, especially in the inward Table of the Skull, caused by the more gross saline and earthy parts (lodged there) and more highly Concreted, than in the outward *Lamina*.

The origin of Skull.

The Skull being framed of many Bones (to prevent great fractures) conjoined by divers Sutures, inserting themselves into each others embraces, after the manner of indented Processes; Sutures are either proper, or common, the first connect the upper bones of the Skull, and the other are common to the Skull and lower Jaws.

The Skull is framed of many Bones conjoined by Sutures.

The proper Sutures, may be taken in a double notion, the first are true, the second spurious: The true Sutures, have an articulation after the manner of a Saw, wherein the Teeth of the Bones belonging to the Skull, are so closely engrafted into each other, that they cannot easily be severed.

The fore is called the Coronal Suture †, styled by the *Arabians*, *Arcualis*, by the *Greeks*, *σφαγις*, by reason either it encircles the Skull like a Crown, or else it is the place, where the Crown useth to be seated on the anterior region of the Head, and passeth from one Temple to the other cross-ways after a Semicircular manner, whereby the Bones of the Forehead and *Synciput* are conjoined.

† T. 46. F. 2. b b b. The Coronal Suture.

The use of this Suture is to joyn the Bone of the Forehead with those of the *Synciput*, and to sever them one from another, as being distinct Bones in themselves, and only united by the interposition of the Coronal Suture.

To this is opposed the *Lamdoidal* Suture † (seated in the hinder part of the Skull) so called, as the Antients imagined, from the likeness it hath with the *Greek* Letter Λ . It is also named by the *Greeks*, *ὀφθαλμοειδής*, and by the *Latines*, *Proræ futura*, the Stern Suture, as lodged in the posterior region of the Skull.

† T. 46. F. 2. Part of the *Lamdoidal* Suture.

This Suture ascendeth in the base of the *Occiput* near each Ear obliquely in several crooked lines, which do Concenter at last as it were in one angle; sometimes when the *Occiput* is large, it is divided by one or two transverse

Sutures, so that it may be called a double or treble Suture, as if a greater triangular Figure should contain within it, one or two lesser Triangles: In this case these Bones of the *Occiput* may be truly styled to be endued with a triangular Figure: Sometimes this Suture sporteth it self in various shapes, some being triangular, others oblong, and sometimes Oval.

† T. 46. F. 2.
cc.
The sagittal
Suture.

The middle or sagittal Suture † passeth in length on the top of the Skull between the Coronal and Lamdoidal Suture, and is carried sometimes all along, the Forehead, parting it into two Bones, which is more common in Infants.

The uses of
the Sutures of
the Skull.

The use of these true Sutures of the Skull, is to give (as some conceive) a freer vent to the steams and excrements of the Brain, and as I apprehend, they are instituted by Nature, to preserve the Skull from great fractures, by reason the Sutures parting the Bones of the Skull do keep the confining Bones from the same violation.

And divers Fibrils are propagated from the *Dura Mater*, and connected to the *Pericranium*, whereby the Brain is kept up, lest the Ventricles of the Brain should be closed up, in violent motions.

The spurious
Sutures of the
Skull.
The first Su-
ture.

The spurious Sutures are two; The first deriveth it self (and is carried upward in a circular progress) from the root of the Mammillary Process, and doth encircle the Bones of the Temples on each side, and tendeth downward to the Base of the Ear, and joyneth the Bones of the *Sinciput*, *Occiput*, and *Sphenoides*, with those of the Temples, after the manner of Scales; whereupon these spurious Sutures are denominated *squamosae* by the *Latines*; This Articulation is somewhat lax, by reason the temporal Bones have some imperfect motion acted by their Muscles in Mastication.

The second
spurious Su-
ture.

The second spurious Suture is brought obliquely from the top of the Scale-like conjunction toward the Orbit of the Eye, and afterward downward toward the origen of the first common Suture, and uniteth the Bone above to the Bones of the *Sinciput*, and below to the Bone of the Forehead.

Four other
Sutures.

And besides these Sutures, there are four other Commissures, which are not properly Sutures, as having no Teeth-like Processes, by which they mutually insinuate themselves.

The first
Commissure.

The first Commissure beginneth from the extremity of the Lamdoidal Suture at the root of the *Os Petrosum*, and goeth obliquely, inclining inwardly at the Base of the Head, and is a kind of additional Lamdoidal Suture.

The second.

The second Commissure seemeth to be a Line, seated in the middle of the Base of the Head, which is carried on each side with a short Duct through the Chink to the *Sphenoides*, and Bone of the Temples.

The third.

The third Commissure may be discerned in the inward region of the fore part of the Skull at the lower Angles of the *Os Sphenoides*, and is carried crossways toward the hinder part, belonging to the Orbites of the Eyes.

The fourth.

The fourth Commissure passeth outwardly with an oblique progress under the two spongy Bones of the Nostrils to the hole of the *Os Sphenoides*.

The common
Commissures.
The first.

The Commissures common to the Skull, and Jaw, are Five in number; The First is seated in the right side of the Orbit of the Eye, and tendeth outward from the termination of the first Suture, and somewhat resembleth a true Suture, and is common to the Bone of the Forehead and to the first Bone of the upper Jaw.

The

The second common Commissure appeareth in the lateral and lower region of the Eye. The second.

The third Commissure climbeth up obliquely from the inward and lateral part of the Eye to the top of the Nose outwardly. The third.

The fourth proceedeth obliquely through the middle of the *Os Jugale*, and joyneth it to the Bone of the Temple; This Commissure is somewhat akin to a true Suture. The fourth.

The fifth doth tend in the Nose from the hinder toward the fore part. The fifth.

The Brain-Pan is made up of two *Laminae* or Tables, which I conceive in their first conception were two distinct Membranes loosely conjoined, or only contiguous to each other in their conception, and are afterward changed into a Cartilaginous, and then into an Osseous substance. The Tables of the Skull.

The outward Table is more thick, endued with a smooth Convex surface, but the inward Table is more hard, unequal, and concave with many winding Cavities, as so many repositories of Vessels, conveyed thither through the *Dura Mater*, and many impressions in the inward surface of the Skull in its first rudiment, when it was endued with a very soft membranous Compag, and the Vessels having once made Cranies, did keep tracts, and cavities, when the Membrane of the inward Table was turned into a cartilaginous and bony nature.

So that an innumerable company of Arteries perforating the *Dura Mater*, pass through divers Cranies engraven in the inward surface of the Skull, and insinuate themselves first into the lower Table, and are thence transmitted through the *Meditullium* into the upper *Lamina*; and both of them are formed at first of a fluid viscid matter, highly impregnated with saline Particles conveyed through the Extremities of the Capillary Arteries, severed from the Blood in the substance of the inward and outward Table, which are very thin and soft in their first production, and grow more thick and solid by new accretions of saline and earthy Particles, which coagulate one after another; So that the two *Laminae* of the Skull (as I conceive) are made by the juxtaposition of many saline and fewer earthy Particles, and consist of many foliaceous fine Flakes, as so many thin saline Coagulations formed one after another, and so closely set together in well fitted Commissures, that the most piercing Eye cannot discern their most exquisitely closed junctures of the many Flakes. Arteries do perforate the *Dura Mater* and Skull.

And the enfoliation of the ambient parts of the Skull seemeth to comply with and confirm this conjecture, by reason when the Skull groweth foul and carious, as being corroded with some corrupt, or venenate Humors in Venereal Distempers and the like, the outward thin Flake is cast off and another subtle accretion discovereth it self, as lodged under the most outward saline coagulation.

And that I may further illustrate the first formation of the Skull, I humbly conceive it will not be altogether improper to treat a little of the manner and way of the Nutrition, relating to the Skull, which is performed in some degree by the *Periostium*, which receiveth Liquor from many small Nervous Fibrils, which very much contribute to the constitution of the membranous expansion of the *Periostium*, and dispenseth the Nervous Liquor through the Extremities of small Fibrils inserted into the *Laminae* of the Skull: And I further conceive that the greatest part of the Alimentary Liquor, appropriated to the Skull, and Bones, is propagated from the Capillary Arteries, creeping through the small cranies of the Skull, wherein the tartareous Particles of the Blood are secerned in its passage, and accreted into the substance of the Brain. The nutrition of the Skull.

Brain-Pan for its Nutrition and increase, and the more sulphureous or oily Particles of the Vital Liquor are severed from the Blood, and other Bones for the supplement of the more unctuous parts, lodged in the Crannies of the *Meditullium* and more large Cavities of other Bones.

The Arteries
enter into the
Compag of
the Skull.

How this Nutrition of the Skull as well as other Bones is performed, I conceive to be somewhat obscure, as the entrance of the Nerves and Capillary Arteries are scarce discernible by what ways they penetrate the smaller Bones; but their perforation in the greater of the Arm and Thigh, are more plain, as having pervious Cavities, conveying Arteries and Veins to the medullary substance reposed in the larger Receptacles and smaller Cavities of Bones: And the Ribs of Infants, and the fungous substance of the Skull is besprinkled with Purple Liquor, which cannot arrive thither any other way but by the smaller Channels of Arteries through the Compag of the Bones into the oily body of Marrow (lodged in the Cells, and greater hollowness of Bones) to impart Life and Nourishment to it, whereupon it is tinged in its surface with a reddish colour, somewhat resembling Blood, in a kind of blush of Red.

Spigelius, a great Master of Anatomy, reporteth, That he saw at *Padua* in a great *Caries* of the *Os Tibia*, the substance of the Bone to be perforated by a small Artery, *Plempius* being present.

And Renowned *Diemerbroeck* giveth the like instance in a young Man, whose *Os Tibia* was foul and very carious in the anterior and most solid part of it, which being made bare from the Flesh and *Periostium*, he saw an Artery strongly beating in the inward cavity of it, wherein the Pulse visibly continued many days in the Bone, where it was divested of all fleshy Particles.

The *Meditullium*,
is full of
Red Liquor
derived from
the Blood.

Thus having discoursed in some manner of the Production and Nourishment of the two Tables belonging to the Skull, it followeth in course to speak of the *Meditullium*, a spongy substance (lodged in the Interstice of the *Lamina*) full of small, some triangular and quadrangular, and other sexangular Caverns, as so many Receptacles of a Marrowy reddish Liquor, propagated from the unctuous parts of the Blood exuding the Extremities of the Capillary Arteries, discharging their oily Particles into the small Cells of the *Meditullium*.

The *Meditullium*
is endued
with many
Blood-vessels.

This spongy substance is furnished with great variety of Arteries and Veins, which are very conspicuous in young tender Skulls, and are rendred more obscure, when the soft and tender substance groweth more indurated and bony in elder persons, upon which account these numerous minute Vessels are received into the *Meditullium*, and conveyed into the *Lamina*, which being perforated with a Trepan, the Purple Liquor may be discerned to issue out of the *Meditullium*, which is called by Divine *Hipocrates*, *διπλόν*, but *Galen* being of another mind, styleth it by the name of the outward and inward *Lamina*, as they are conjoined.

The *Meditullium* is bedewed with plenty of Blood, dispensed to it by the numerous Carotide Arteries, whereupon *Hipocrates* rightly judgeth it to be obnoxious to Inflammations, generated by a quantity of Blood impelled out of the terminations of Arteries, and stagnated in its spongy substance.

This loose Compag is not only accommodated with many Arteries and Veins, but Nervous Fibrils too, which may be plainly evinced by the application of the Trepan, first piercing the glazed and incrustated part of the Skull,

vid.

vid. the upper *Lamina*, wherein the Patient findeth himself not aggrieved, but when the *Meditullium* is touched, whereupon immediately the Patient is rendered uneasy, as being affected with pain, which must arise from nervous Fibres, residing in, and giving sense to the *Meditullium*, in which the numerous vessels are accompanied with little conglobated Glands, which *Hypocrates* calleth

The Glands of the *Meditullium*.

σπερμα, ὅτι ὅ καὶ πᾶν ἐν ἐαυτῷ, ὁμοία σπερμα πολλά· καὶ ὕδα, καὶ εἰ τις αὐτὰ διατρέχει τοῖσι δακτύλοις αἷμα δα- γίνοιτο ἐξ αὐτῶν, ἐνὶ ὅ ἐν αὐτῷ ὁρεῖα, καὶ φλεβία λεπτότερα καὶ κοιλότερα, αἵματος πλέα. Totum Os Capitis (parte exigua excepta) spongiam refert plenam. Carunculis multis & humidis, quas si quis terat digitis, sanguis exit, immò in osse venas tenues sanguine plenas reperiet.

The Blood is carried by the carotide Artery into the Caruncles, or rather Glands of the *Meditullium*, which are so many Colatories to strain the finer parts of the Blood, from the more gross, saline, and earthy, which are transmitted from the *Meditullium*, to the Tables of the Skull, but the more refined parts of the vital Liquor, are returned by the Jugulars into the *Dura Mater*.

These Glands lodged among the Vessels in the *Meditullium* may best be discovered in Hydropique Bodies, and especially in the Dropfy of the Head, which was called by the Antients, *Hydrocephalus*.

The Glands appear in Hydropique Bodies.

And not only the *Meditullium* belonging to the Skull, but the *Dura* and *Pia Mater*, and all other Membranes are furnished with many minute Glands, as I have shewn heretofore in the Glands of the *Cutis*, and will Discourse hereafter (God willing) in the Coats of the Brain, as so many strainers of the Blood from its *Fæces*, thrown off by excretory Ducts, in Transpiration and Sweat, or returned by the Lymphæducts and Veins, while the more refined parts of the *Succus nutritivus* Liquor, are assimilated into the Vessels and Fibres, which do constitute the membranous, and muscular parts of the Body.

This loose Compage of the Skull hath different Dimensions in several persons, and is so thin in some places, that it can scarce be discerned, by reason the Tables are so closely conjoyned, that they seem to make one entire transparent Body.

The Skull hath a different thickness.

Learned *Bartholine* relateth, that he dissected a Skull, in which the *Meditullium* was wholly deficient, which perhaps was occasioned by absumption of it in old age, in which it may be so dried, that it may be difficult to discover it, or rather this famous Author dissected the Skull in that part, where both the Tables are closely conjoyned, without any visible interposition of a *Meditullium*.

The Figure of the Skull.

As to the shape of the Skull, Man may be fitly entitled a Microcosme, as being, not only an Epitome of the greater World, by holding an Analogy with it in variety of Parts and Humors, but by emulating the Globe of the Universe in its spherical Figure, in which the noble part of the Brain is safely immured, as in choice repository, to secure it against the violent attempts of outward hostilities.

But if the Skull be strictly viewed with a critical Eye, it will be found not exactly orbicular, but somewhat oblong in its Shape, and flattish in its Sides, and more protuberant in the Forehead, and hinder part of the Head, and whatsoever Figure deflecteth from the former, is more or less imperfect, either as wanting the Anterior, or Posterior Protuberance; or as being too much depressed on each side, or too much acuminated on the top, whereupon the tender and excellent frame of the Brain must suffer greater or less disorder, as being more or less violently compressed by the unnatural Shapes of

the Skull; which take their rise, either in their first formation in the *Uterus*, or in a difficult Birth, proceeding from a large Head, violently crouded through the great straights of the *Ossa Pubis*, and *Coxendicis*; whereupon the soft Skull of Infants is easily compressed by the resistance of the hard ambient parts; or when the disordered Figure of the tender Brain-pan, is made by the rough hand of the Midwife, strongly haling the *Fœtus* by the Head, forceth an unkindly Birth; or else when the shape of the Child after Birth, is deformed by the Nurse, in the over-straight binding the Head with Cloths.

The Brain is not configured by the Skull.

Some are of an opinion, that the Brain borroweth its Figure from the Skull, which being of a hard Compage, forceth the tender frame of the Brain to comply with it in shape; but it is more consonant to reason, that the Brain being the more noble part, doth challenge the privilege of *Primogeniture*, and the Skull is ministerial to it as a Cabinet to preserve the Brain, as a more excellent Jewel; or as a Chappel built, and Consecrated to the celebration of the Divine Offices of the Brain; and the Brain being first formed, modelleth the most soft frame of the Skull, which is very pliable, as being first a membranous substance, whose Concave-Surface is easily configured by the orbicular Convex Compage of the *Dura Mater*, plainly evidenced by the Cavities, engraven in the inside of the inner Table of the Skull, as so many little Cells to entertain the protuberant Vessels of the *Dura Meninx*, which have made their impressions upon the tender Surface of the Skull, when it was membranous in its infancy.

The situation of the Head.

The Head is a Globe set upon the top of this pile of elegant Building, in the highest part of the Microcosme, partly in favour of the Eyes, seated in Two orbicular Caverns in an eminent part of the Body, to give them the greater advantage, as being Sentinels to guard their fine Fabrick from outward damage, and violence, and ordained by Nature to be guides, to conduct us safe in progressive motion.

The use of the Skull.

And the Skull, the more solid part of the Head, is consigned by the Grand Architect, to be a repository for the Brain, severed from other parts of the Body in the highest Apartment, to celebrate the most excellent operations of the Soul, Sensation, and Reason; so that the Skull being instituted by Nature, for the preservation of the noblest part of the whole Body, is not integrated of one entire simple part, which would be thereby more obnoxious to Fractures, but compounded of many strong firmly conjoyned parts, by various fit articulations; and is divided into Six Bones, viz. the *Ossa Frontis*, *Syncipitis*, *Occipitis*, *Temporum*, *Sphenoides*, and *Ethmoides*.

T. 46. F. 2.
a a a.
The Figure of the Forehead.

The *Os Frontis* † is a large Bone, almost of a circular Figure, and is double in Infants, being divided in the middle by the Sagittal Suture, running down to the top of the Nose, which is so exactly obliterated in mature age, by the firm union of the Bones, that the least Fissure cannot be discerned.

The situation of the Forehead.

It is seated in the Anterior part of the Head, united in its inferior Region to the *Os Sphenoides*, *Ethmoides*, and the upper Mandible, and above to the Coronal Suture, and hath Two semicircular Processes (hanging over the Eyes) which terminating at their Angles, do make the upper Orbites.

The Origen of the Forehead.

The Forehead being the Anterior Region of the Skull, is clothed the first two Months, in reference to its Origen, with a membranous Expansion, as with a softer Coat, borrowed from the viscid Particles of the

the seminal Liquor, swimming upon the ambient parts of the Brain, which the third Month changeth its habit, putting on a more solid covering, and as a membranous Integument is turned Cartilaginous, derived from saline and earthy Particles, severed from the Blood, impelled by the capillary Arteries, into the substance of this grisly part.

About the orbites of the Eyes may be spied as through a Veil, some little spots in the center of the Suture, belonging to the Forehead, as the First-fruits and Earnest of an approaching Ossification.

Above the orbites of the Eyes may be discovered a bony Arch (which contrary to the order which Nature observeth in the production of other Bones in the Skull) beginning first in the circumference, and is after expanded toward the center of the Forehead, but in the other bones of the *Sinciput*, *Occiput*, and the rest, their Ossification first ariseth in the middle, and afterward determineth in the Perimeter.

In the Fourth Month the *Os Frontis* groweth much more solid, as receiving a greater proportion of saline and earthy Particles; whereupon the greatest part of the Forehead is rendred bony, except about the *Os Cuneiforme*, and *Temporum*, by reason the Ossification of the Forehead, is enlarged toward the *Os Sincipitis*, and the Fontanell.

In the Fifth and Sixth Months, the cartilaginous center of the Forehead is concreted into Bone, and the Fontanell lessened, and the specks seated about the Orbites of the Eye grow wholly bony.

In the Eighth and Ninth Months, the Anterior Integument of the Brain is consolidated into one uniform, more firm and hard Bone, to guard the tender frame of the Brain from ill accidents,

Near the Forehead, about the confines of the Eye-brows, and the top of the Nose, are placed between the two *Laminae* now and then one, but for the most part two Caverns, endued sometimes with equal, and other times with a different Magnitude, and do often vary their manner of situation; some Skulls have one large Cavity, inclining toward one side of the *Os Frontis*, and a much smaller is found in other Foreheads, whose Bones are parted by the Sagittal Suture, which is rare in persons of mature age.

Learned Dr. *Higmore* relateth, that he observed two Cavities, one of each side (alike in greatness) from which two holes were perforated into the Nostrils: But in others, whose Foreheads are naturally depressed, oftentimes there cannot be found the least footsteps of any Caverns, as the Author reporteth of a Woman he Dissected, who was endued with a flat Forehead.

These Caverns, whether one or more, are furnished with two passages, one derived from the Brain to the *Os Ethmoides*, and from thence another is imparted to the Cavities of the Nostrils.

These Caverns of the *Os Frontis* are small in Man, and much larger in Brutes, as in Sheep and Horses, which have considerable long Caverns, in which are generated a kind of Worms, rendring Bullocks vertiginous, which skilful Cow-leeches cure, by opening these Cavities, and taking out the Worms.

Divers Learned Authors speak their various Judgments concerning the use of these Caverns; some are of an opinion, that they are receptacles of Humors, bedewing the Eyes, to render them more pliable in order to motion, which is hard to be understood, by reason a thick Mat

The Process
of the Fore-
head in the
Fourth Month

The Process
in the Fifth
and Sixth
Month.

The Caverns
near the
Forehead.

The Caverns
of the Fore-
head are
small in Man,
and more
large in
Beasts.

The use of the
Caverns of
the *Os Fron-*
tis.

ter

ter is lodged in those Caverns, which if transmitted to the Eyes, would darken the Sight, and by stifning them, would render them uneasy, in reference to their quick turnings, to view Objects in indifferent Situations.

Others consign these Cavities to a noble end, to prepare the Air for the production of Animal Spirits, to which no rational Man can easily assent, seeing the purity of it must be rather lessened then advanced, as being annoyed (in its passage into the Brain) with the impurity of mucous Recrements, often lodged in these Caverns.

Learned *Highmore* conceiveth, that Nature framed them to constitute the Eminencies and Protuberancies of the Eye-brows, which give a grace to the Face, and a defence to the Eyes; It may be these Cavities are framed to make a diversion of ill Smells, that they should not give too great a surprize and trouble to the Brain.

The true use
of the Ca-
vems.

But I conceive the most probable use, that may be assigned to these Caverns, is that they are Receptacles of mucous Matter, in that they hold an intercourse with the Brain, by passages conveying excrementitious Matter from the Ventricles of the Brain, strained through the *Os Cribriforme*, and transmitted into these Cavities, and from thence by another passage conveyed into the Nostrils, and from thence discharged the confines of the Body.

The situation
of the *Ossa*
Sincipitis.
† T. 46. F. 2. d.
f.

The *Ossa Sincipitis* † seated on the top and sides of the Head, if considered singly, have an unequal Quadrilateral Figure, and if joyntly taken, are endued with a Semi-circular Convex form; and have a Connexion before with the Bone of the Forehead, and behind with the *Occiput*, by the Lamdoidal Suture; and on the sides with the Bones of the Temples, by Squammous agglutinations.

The cause of
the Laxity of
these Bones.

These Bones are more thin then any other part of the Skull (whereupon Wounds prove here most fatal) and are soft and membranous in Infants, principally about the Commissures of the Coronal, and Sagittal-Sutures, by reason of an exuberant moisture, causing an *Hiatus*, called *Fontanella*, which is afterward indurated into Bones.

The use of the
Laxity of
these Bones.

The softness of these Bones rarely continueth in persons of mature age, though *Diemerbroeck* reporteth, he saw a *Fontanel* in a Person of Honour, Forty years old; And *Lindannus* giveth an account of the Laxity of these Bones in a Woman of Thirty years, who upon the Head-ach, or in time of her Travel, had the Coronal-Suture opened a Fingers breadth; so that the pulsation of the Arteries in the *Dura Mater* might easily be discerned.

I conceive a double use may be assigned of this *Hiatus* or Cavity in Infants, the First may be to exonerate their moist Brain, as clogged with gross Vapours, breathed through this membranous substance. Secondly, That these tender gaping Bones may be drawn closer together, to grant a more easy passage to the Head in the time of Birth, through the straight Bones of the *Hypogastrium*.

The Origins
of the *Ossa*
Sincipitis.

In the Three First Months, the *Ossa Sincipitis*, or Side-bones of the Skull, have only their rough draughts, wherein they appear membranous first, and afterward Cartilaginous, and have only some obscure points as so many glimerings through a Cloud, bespecking the Cartilaginous substance of the *Ossa Sincipitis*, which afterward in the Fourth and Fifth Months, are intermedially step by step turned into Bone, and begin their

their progress (contrary to the *Os Frontis*, from the Center to the Circumference.

In the Sixth and Seventh Months the Sutures are formed, and begin somewhat to close, being loosely conjoined *per Harmoniam*, but their edges confining on the *Os Cuneiforme*, and *Temporum*, retain their first membranous Nature; whereupon the Bones being separated one from another, there appeareth a great aperture, which disappeareth in the Eighth or Ninth Month, as the Bones of the *Sinciput* are perfectly united with the *Os Sphenoides*, and *Temporum*.

The Origins
of the Su-
tures.

The *Os Occipitis* is made up of the hinder and lower parts of the Skull, and is one Bone in persons of ripe age, except very rarely, when there is a *Lusus Naturæ* in those who have a most spacious hinder part of the Skull, which is then compounded of many Bones, after a different manner, divided with Sutures of various shapes: It is common in Infants to find many Bones in the hinder region of the Skull, which are Six or Seven, according to some Anatomists: But Learned *Fallopins* affirmeth, he could never discern above Four.

The composi-
tion of the *Os*
Occipitis.

The *Os Occipitis* is beautified with a Triangular Figure, and is Convex without, and Concave within, and is endued with a harder and thicker Compage, then any other part of the Skull, by reason we are often surprized with dangerous falls backward, against which we have no defence, but the hardness and thickness of the *Os Occipitis*.

The Figure of
the *Os Occi-
pitis*.

This Bone hath a Connexion above with the *Sphenoides*, and is adorned with Nine *Sinus*, of which Two are Engraven in the lower part, about the sides of the great *Foramen*; in the inward Surface of this Bone, are seated Seven *Sinus*, of which the Two lowest and greatest are repositories, to receive the Protuberancies of the *Cerebellum*.

The Connexi-
on of this
Bone.

Seven *Sinus*
of the *Os*
Occipitis.

Near these *Sinus* appear Two other, on each side the *Occiput*, which ascend obliquely from the *Ossa Temporum*, and pass cross the *Os Occipitis*, in whose Center do meet, and are entertained the Two lateral *Sinus* of the *Dura Mater*; from these a Third straight *Sinus* climbeth up to the *Ossa Sincipitis*, receiving the upper and great *Sinus* of the *Dura Menynx*: At the sides of the right *Sinus* are placed Two other *Sinus*, giving reception to both the hinder Protuberancies of the Brain.

At the side of the great *Foramen*, through which the Spinal Marrow is transmitted, are seated Two Processes looking inward, which are accompanied with Two other smaller ones, tending; all which are received with a smooth Cartilage from the *Sinus* of the first *Vertebræ*, waiting upon the articulation of the Head: These distinctly opposite Processes, Two other Prominencies attend; so that in the same place a Bone is outwardly and inwardly protuberant. To these Processes may be added the Fifth and greatest, giving strength to the inferior Region of this Bone, where it is slender and weak, which ascendeth inwardly upright from the great *Foramen*, dividing the Two Protuberancies of the *Cerebellum*.

Two Process-
es of this
Bone.

Two other
Processes.

The Fifth
Process of the
Os Occipitis.

The *Os Occipitis* hath Five *Foramina*, one of which is the lower and greatest, and through it, the *Medulla Spinalis* is conveyed, and at the sides of this great hole, are placed two other, to give a passage for the Seventh pair of Nerves, and to the Artery and Vein belonging to the Head.

The Five
holes of this
Bone.

Not far from the sides of these holes, under the *Os Petrosum*, between the *Occiput* and the *Processus Stiloides*, is placed an oblong *Foramen*, affording a way to the first pair of Nerves, and the carotid Artery, and Jugular Vein.

The Figure
and Compo-
sition of the
Os Occipitis.

This Bone belonging to the *Occiput*, is of a Triangular Figure, and is rarely composed of one, but most commonly of many Bones, sometimes of Two, and other times of Three, and now and then of Four.

The Rudi-
ment of the
Os Occipitis.

In this Triangular Bone the *Lamdoideal Suture* hath its terminations, as it were made of Two crural Processes, in which some Branches pass cross-ways from one Extremity to the other; and is severed from the other Bones, (containing the Two small Heads or Processes of the *Occiput*) called by *Galen* *κορωνα* which insinuate themselves into the *Sinus*, engraven in the first *Vertebre* of the Neck; this variety of Bones (adorning the *Occiput*) is visible in the Third Month, of which the Rudiments appear only in the Second, as being membranous or cartilaginous. In the Fourth Month the Bones being completed, do coalesce into one.

The manner
how these
Bones are
formed in
the *Fœtus*.

This number of Bones (I conceive) is thus occasioned in the *Fœtus*, because in the Third Month, the *Os Triangulare* is partly bony, and partly cartilaginous, whose Particles interceding in diverse places, the imperfect Bones do seem to make many, which are not in truth many distinct Bones, but parts belonging to one, which is very conspicuous, when the cartilaginous interpositions, growing bony, fill up the vacuities, rendring the *Os Triangulare* one entire Bone, to which, after it is united, accresceth a new Bone, which may be styled *Os Tricuspitale*, touching with one point the *Os Triangulare*, and reaching the Two other toward the *κορωνα* below; about which may be also sometimes observed another *Os Tricuspitale*, Two of its points, (acosting the *κορωνα*) do embrace them near their Origen; and the Third tending toward the *Os Sphenoides*, is not conjoyned to it: This Bone in the divarication of its Sutures, and Processes, observeth no set method, but sporteth in great variety.

The situation
of the Bones
of the Tem-
ples.

The *Osse Temporum* are seated on each side of the Head, of which the external parts are called *Osse Squamosa*, as being joyned after the manner of Scales to the under Bones, which are called *Osse Petrosa*, by reason of their great hardness: and are so thin in the middle, that they seem transparent, when exposed to a Candle; and in their upper part they resemble the Segment of a Circle: and are adorned with divers Processes, one of which and the most remarkable, is composed of the Prominencies of Two Bones, conjoined in an oblique Suture, and its Posterior part being a Process of the *Os Temporum*, is emitted toward the Face, with a crooked *Apophysis*, and by the conjunction of a Process with the upper Mandible, doth constitute the *Os Jugale* † wisely instituted by Nature for the defence of the temporal Muscle, safely reposed under its Arch.

The Proces-
ses of these
Bones.

From the inferior Region of these Bones, are derived the Mammiforme Processes, which being of a Pyramidal Figure, begin with greater Bases, and end into obtuse Angles.

From these Bones also arise Two smaller Processes, or rather Appendices, taking their Origins in less Bases than the other, and terminate into more acute Angles.

The *Osse Petrosa* are endowed with Three eminent *Sinus*, one of them receiveth into its bosom, the obtuse Process of the lower Mandible, which is united to the *Os Petrosum* by a membranous Ligament.

The other being common to the *Os Occipitis*, doth render inwardly hollow the back part of the Process, belonging to the *Os Petrosum*.

The Third is the most useful and largest *Sinus*, containing the auditory Nerve.

† T. 46. F. 3.
cc.

The *Ossa Temporum* are furnished with Five Perforations, the First is easily discernible in the *Os Petrosum*, ordained by Nature for the conveyance of the Fifth pair of Nerves.

The Five Perforations of the Bones of the Temples.
T. 46. F. 3^d
d d.

The Second Perforation is more large and unequal, seated under the *Processus Stiloides* † and transmitteth the greater Branch of the carotide Artery to the Brain, by the Fifth hole of the *Os Sphenoides*.

The Third Perforation, relating to the *Os Temporum* is also considerable, and is common to the *Occiput*, giving a passage to the irregular vein, and the lesser branch of the carotide Artery, and to the First pair of Nerves.

The Fourth Perforation hath its seat between the *Processus Mammiformis*, and *Styloides*, and transmitteth through a long Channel, the harder branch of the Fifth pair of Nerves.

Having given a description of the Bones of the Temples, I will make bold to shew the First origination of them; which in the Two first Months of their imperfect production, are araid with more soft attire of a membranous Compage, as their ruder delineation tending to a bony substance.

The Origins of the Bones of the Temples.

In the Third Month the *Processus Zygomaticus*, being an Appendix of the upper Mandible, appeareth wholly concreted into Bone, while all the other Bones of the Temples retain their Cartilaginous Nature; except the Circle seated in the *Os Petrosum* (to which the Membrane of the *Tympanum* is affixed) which putteth on the substance of a Bone so finely spun, that it is drawn out as small as minute Filaments.

The Origin of the *Processus Zygomaticus*.

The *Processus Styloides* is a Cartilaginous point, (lying along, and resting near the bony Circle) and is erected long after its Birth, and is afterward turned into a tender Bone.

The Origin of the *Processus Styloides*.

In the Fourth Month the *Os Squamosum* may be discovered, and the Perforation of the Ear to be rendred bony, after the manner of a Long unequal Line, drawn out somewhat beyond the bony Circle.

The Rudiment of the *Os Squamosum*.

CHAP.

C H A P. XXVII.

Of the Skulls of Beasts.

The first covering of the Skull of a Calf.

THe Skull of a Calf is enwrapped within Five Integuments; The first is that of short Hair every way dressing the Skin of the Head as with a shady Vail.

The second Integument.

The second covering is the Skin, which being the most thick and solid, encircleth the *Membrana Carnosa*, and is composed of many minute Glands (besetting its inward parts) accompanied with Excretory Ducts, or numerous small Pores, through which the hot steams of the Blood do transpire.

The third Integument.

The third Coat of the Skull is the *Membrana Carnosa*, which is very thin in this place, enclosing the fourth Integument of the *Pericranium* (in its lower region) to which it is fastned by many minute membranous Fibrils, tying these Coats one to another; and this covering of the *Membrana Carnosa* (next in order) as well as thickness to the Skin, is endued with many fleshy Fibres, which give strength to this Integument, as well as motion, which is found in other parts of the *Membrana Carnosa* in Beasts.

The fourth Coat.

The fourth Coat is the *Pericranium*, which immureth the *Periostium* in its inward circumference, and is made up of many Fibrils, and small Nerves (derived from the *Dura Mater*) whereupon it is endued with an acute sense.

The fifth Covering.

The fifth Integument of the Skull, is a most thin Tunicle, covering it, as with a fine white Vail; and is made up of many most minute well spun and closely interwoven Filaments, interspersed with small threads of Nerves, rendring it of a quick sensation.

The outward Table of the Skull.

The second Table.

Having treated of the various Integuments of the Skull, I come now to its more peculiar Compage which consisteth of two Tables; The outward is more hard, as glased with a white polished, shining Surface; The inward Table is more rough, as having many small Furrows, made by the neighbouring Vessels of the *Dura Mater*, compressing it in its first production, as being tender and membranous.

The Medullium of the Skull.

Between these Tables is lodged the *Meditullium*, composed of a marrowy spongy substance, interspersed with many carnous Particles, or rather small Glands.

The Coronal Suture.

This Skull as well as that of Man's, is framed of many parts conjoined by various Sutures, the first is the Coronal, seated in the beginning of the Skull, or Forehead, and encompasseth the origen of the Nose, and some part of its sides, after the figure of an Arch or Semicircle.

The Sagittal Suture.

The fore part of the Skull in a Calf, is endued with a hollow surface, through which and the more prominent part of the Head, the *Sinciput*, the sagittal Suture, (passing in the middle of the Skull and making many Angles,) uniteth the Bones of the Forehead and *Sinciput* with many small indentments, or rather by *Harmonia*, or Simple Line.

The Lamdoidal Suture.

The *Occiput* is accommodated with the Lamdoidal Suture, running crossways on each side of the Skull in an oblique or crooked posture under the sprouts of the Horns in this Bull Calf; This Suture with short indented

Pro-

Processes fastneth the anterior to the hinder part of the *Occiput*, rendring it adorned with a triangular Figure (endued with unequal sides) whose Base is seated in the lower part, and its upper hath an Angle conjoynd to the anterior part of the *Occiput*.

The Figure of the hinder part of the *Occiput* is triangular.

The Skull of a Lamb is covered with many Integuments, as Wool, the *Cutis*, *Pericranium* and *Periostium*, which is the most fine covering, immediately encircling the upper Table of the Skull.

The coverings of the Skull of a Lamb.

The Skull of this Animal is most round and prominent in the *Occiput*, and more plain and flat in the anterior region of the Head.

The Figure of the Skull.

It hath two Sutures, the one sagittal (going from the Lamdoidal Suture to the fore part of the Head) dressed with indented Processes, shooting themselves into each other, whereby the Bones of the Skull are mutually fastned; this Suture is extended to a Fissure, passing down all the middle of the Nose.

The Sagittal Suture.

The hinder part of this Skull is endued with a Lamdoidal Suture, conjoynd to the Sagittal, and passeth obliquely crossways through the Skull, and determines on each side near the Ear.

The Lamdoidal Suture.

The Skull of a Pigg is most protuberant in the top of the *Sinciput*, and is less in the hinder region of the Head, and hath no Lamdoidal Suture, in which it differeth from a Humane Skull, which is much rounder, and larger than any other Animal, if a reference be had to the dimensions of Man's Body.

The figure of the Skull of a Pigg.

In the Skull of this Animal are two Perforations (through which the Blood-vessels have a passage from the *Dura Mater* to the *Pericranium*) attended with two arched Channels, leading into holes seated in the beginning of the Skull, on each side of the origen of the Sagittal Suture; which taketh its rise near the upper Extremity of the Nose, and passeth along the middle of the *Sinciput* (dividing it into two regions) and endeth at the Coronal Suture, which maketh its progress crossways over the Skull, and is endued with the figure of an Arch, passing over the Skull, and endeth near the outward Angle of the Eye.

The Perforation of the Skull.

The rise of the Sagittal Suture.

The progress of the Coronal Suture.

The situation of the Coronal Suture.

The Coronal Suture in this Animal is different from that of Man in its situation, as it confineth on the Termination of the Sagittal Suture in a Pigg, and in a Man on the origen of it.

The Coronal Suture found in a Piggs Head is obliterated in the Skull of a Bore; so that the *Sinciput* and *Occiput* are conjoynd without the interposition of any Fissure, and the Sagittal Suture is so obscured, that it can scarce be discovered in the Skull of a Hogg.

The Coronal Suture is obliterated in the Head of a Bore, and the Sagittal much obscured.

The figure of the Skull of a Hare.

The Skull of a Hare having a round protuberant figure is endued with Sagittal, Coronal, and Lamdoidal Sutures, taking their progresses in various Lines in length, crossways, and in crooked positions.

The Sagittal Suture is very long in this Animal, passing between the Lamdoidal and Coronal Suture through the middle of the *Sinciput* in a right line, and adjoyneth in its origen to a Fissure, which I conceive is a continuation of the Suture all down the Nose (to the *Pinna*) and divideth it into equal portions, as it is also found in a Pigg and other young Animals.

The Sagittal Suture.

The Coronal Suture is seated in its origination to the upper Extremity of the *Ossa Narium* by which they are united to the Bones of the *Sinciput*, and begin near the upper part of the *Orbitus* of the Eyes, and from thence are carried obliquely in two sides, which meet and end in an acute Angle.

The Coronal Suture of a Hare.

The Lamdoidal Suture (by which the *Os occipitis* hath a connexion with the *Ossa Bregmatis*) is carried cross the beginning of the *Os occipitis* in

The Lamdoidal Suture.

oblique Lines, till they arrive at two Processes common to the *Ossa Bregmatis* and *occipitis*, where this Suture maketh Angles near the outward Angle of the Eye, where it is reflected in a Ridg after the manner of an of Arch, on both sides of the outward margent of the *Os occipitis*, between it and the *Os petrosum*.

CHAP. XXVIII.

Of the Skulls of Birds.

The first Coat
of the Skull
of a Cock
Turkey.

THe Skull of a Cock Turkey is covered with three Coats; The first is the *Cutis*, and the thickest, having its outward surface dressed with Feathers and full of many Protuberancies, endued with various shapes and sizes, which I conceive are divers Glands, beset with numerous Vessels of several kinds: This Coat terminates into a long Pyramidal Process (furnished with a soft spongy substance full of small Glands) growing much tumefied with Blood, when the Turkey is aggrieved by some ill encounter, threatening danger, as it is apprehended by this angry Animal.

The second
Integument.

The second Coat encompassing the Skull is much thinner then the other (and holdeth much analogy with the *Pericranium*) and is furnished with many minute Glands.

The third Tu-
nicle.

The third is a fine Tunicle, which may be styled the *Periostium*, immediately encircling the Skull as with a thin Vail.

The tables of
the Skull.

The Skull of this Bird is composed of two Tables (as it is found in other Animals) between which is lodged a spongy Medullary substance, very thin in Birds; The surface of the first Table is rough and uneven, as hollowed with many small Furrows, running in several positions; The Skull hath its outward surface Convex on the top, and its inward Concave.

The Coats of
the Skull of a
Goose.

The outward
Surface.

The Skull of a Goose is covered also with three Coats, of which the uppermost is most thick, (adorned with many small Feathers) and the most inward (called the *Periostium*) is most thin, and the middle or *Pericranium* is accommodated with many Blood-vessels; the outward in some is Concave, and hath a hole placed about the middle of the Cavity (which is beautified with two Arches about the middle running between the Eyes) terminating into the Mammillary Processes, where the Beak taketh its rise, and hath a perforation made in a Furrow passing between the said Processes, for the Egress of a Blood-vessel out of the Brain.

The Figure
of the Occi-
put.

The *Occiput* is more protuberant than the other part of the Skull, and is embellished with a kind of Globular figure, except in the middle, where it is covered with an Oval shape, and here the substance of the Skull is very thin.

The spongy
substance co-
vering the
Brain.

The Brain is enclosed with a fine spongy substance, beset with many small Glands, and invested with a thin Film.

The Coats of
a Duck.

The outward part of the Skull is engraven with many Cavities, like so many Lines, running in irregular postures.

The Skull of a Duck (as well as other Birds) is clothed with three Coats, of which the outward is most substantial, dressed with many fine Feathers, and hath a Trench, passing the whole length of it, which is most narrow between the

the Processes of the *Occiput*, and groweth more enlarged between the Eyes, and is most deep near the origen of the Bill, guarded with two oblong prominencies.

The *Occiput* in this is less protuberant then that of a Goose, and is adorned with two Oval Processes ending in points toward the Eyes, and have more obtuse Cones toward the termination of the *Occiput*.

The Figure of
the *Occiput*.

The Skull of this Bird, as well as others, is endued with two hard bony Tables, between which intercedeth a red spongy substance, furnished with many small Cavities, filled with a Medullary substance.

The table of
the Skull of a
Goose.

The Skull of a Cock or Capon is most prominent on the top of the Head near the Eyes, and is concave near the Bill, and terminates into a more even *Occiput*, which is less protuberant then that of a Duck or Goose.

The figure of
the Skull of a
Cock.

And the Skull of this Bird hath an oblong narrow Trench, passing in the middle of two large Processes, seated between the Eyes.

The *Occiput* hath an oblong process, attended with a Cavity on each side.

The Skull of a Cormorant is immured with Five Integuments; The first is composed of Black Feathers, interspersed with White; The second covering is of a white, short, and thick Down, so closely fastned to the *Cutis*, that it can scarce be separated from it; The third is a *Cutis* of a membranous substance more substantial then the other Coats: The fourth is the *Pericranium* endued with fleshy Fibres; and the fifth covering is a thin Tunicle, immediately encircling the Skull.

The first Coat
of the Skull of
a Cormorant.
The second
Coat.
The third
Coat.
The fourth
Coat.
The fifth
Coat.

The Skull of this Bird is composed of a hard bony substance, endued in the anterior part with a more narrow figure near the Bill.

The substance
of the Skull
and its Figure.

The *Occiput* is much broader then the fore part of the Skull, and endeth in a Globular figure, covered with a Muscular substance; And hath an oblong narrow Appendage, running like a Ridg on the top of a bony Process (enclosing the *Cerebellum*) carved on each side with an arched transvers Process.

The outward surface of the Skull of this Bird is for the most part plain, and hath only a small dent passing from the *Occiput* to the Beak.

CHAP.

CHAP. XXIX.

Of the Skulls of Fish.

The dimensions of the Skull of a Porpoise.

The Sutures made for the most part per harmoniam.

The situation of the Sutures.

The Organ of Hearing in a Porpoise.

The situation of the Instrument of Hearing.

The Coclea in the Ear of a Porpoise.

The holes in the *Os Petrosum* made for the passages of the Auditory Nerves.

The *Os Petrosum* is composed of many Bones.

The Muscles rendring the Membranes of the Ear tense.

The Skull of a Porpoise (of which Learned Dr. Tyson giveth a good account in his Treatise of the Porpoise) hath greater dimensions in breadth than length, which is rare in other Animals.

The Sutures were made in simple Lines (as not insinuating themselves one into another, as in a Humane Skull) except in those of the *Occiput*, which are endued with small Indentments.

The situation of these Sutures is different from that of Man's.

The Coronal Suture is deficient in this Animal, and instead of it, was seated a large prominency of the Skull, and in the middle of the Forehead is lodged a protuberancy, rising up above the other parts of it.

The *Os Petrosum* in this Animal is very different from other Animals, and much worthy our remark in reference to the Organ of Hearing, which hath a minute auditory passage (attended with no Auricles without) to prevent the reception of Water, which else would prove prejudicial.

The Organ of Hearing is seated in a large Cavity, engraven in the *Os Petrosum*, not fastned by Sutures, or joyned together by the union of many Bones, by the interposition of Muscles, (as the said Curious Author hath observed.)

This Bone (as in other Animals) is called *Petrosum* from its eminent hardness, and is beautified with a White Colour, and endued with an irregular Figure.

Within the *Os Petrosum* may be discovered (upon sawing the Bone) a Trench winding in various positions (resembling the *Coclea* in Man's Ear) and leading to the *Tympanum*, lodged a little within the Ear.

Near the *Processus Mammillaris*, are placed three large Protuberancies, and within the opposite Terms are rendred hollow, and when the Bone is taken out, you may see a large Cavity, that goeth to the inward Recesses of the Ear: And in this Bone are found many holes, that give a reception to the auditory Nerves (in their passage toward the *Coclea*) the immediate Instrument of Hearing, to which all other parts of the Ear are subservient.

The *Os Petrosum* is not one entire Bone, but consisteth of many, united in the fore part, where the *Tympanum* is lodged. This Bone being parted by Art, some part is more thick, and the other a more thin *Lamina* making up the Cavity of the auditory Bone, of which the thick portion is accommodated with three Protuberancies, the middlemost is seated over against the *Tympanum* at its outside, and hath a large Foramen made for the ingress of the auditory Nerve.

The Bone in its winding Cavity, is somewhat like a *Coclea*, as being carried spirally; and at its inside go several minute Muscles, or rather large Carnous Fibres, which by their contraction render the Membrane Tense; and the Cavity being very large in its Posterior part, Nature wisely framed the

the Walls of the Bone very thick and dense, that the sound may become more intense by the greater Collision of Air made upon so solid a Body.

The use of the thickness of the *Os Pre-trosum*.
The *Os Triangulare* is different from that of Dogs.

Within the *Cranium* of this Fish may be found a Triangular Bone, somewhat different from that of Dogs, having at its Termination a Prominency somewhat resembling the Comb of a Cock; from this Bone, proceedeth a Protuberancy (instead of the *Sinus Longitudinalis*) passing the whole length of the *Cranium*: This Protuberance parted the two Hemispheres of the Brain, as the *Os triangulare* severed the *Cerebrum* from the *Cerebellum*.

The Skull of a Carp is a hard firm Compage, made up of whitish Cartilaginous Fibres, interspersed with more strong Cartilaginous Processes, running in length and ending in a strong Cartilaginous Semicircular Process (passing cross-ways somewhat above the Eyes) somewhat resembling the Coronal Suture in point of its position.

The Compage of the Skull of a Carp.

The Cartilaginous Fibres of the Skull, being guarded laterally with a strong bony Protuberance, do make their progress in bevil Lines; a little above the great Cartilages, covering the Gills.

The progress of the Cartilaginous Fibres.

Above the Eyes on each side, is seated a squamous Suture, endued with a bony substance made up of many Processes; These Sutures begin in more large expansions, and end into a kind of obtuse Cones, and are beautified with a Semilunary Figure) encircling a great part of the Eye.

The situation and substance of the *Os Squamosum* and its Figure.

The Skull of a Roach hath two strong oblong bony Processes like Columns (guarding each side of it) to which on each side is appendant a transverse Process going toward the Eye.

The Processes of the Skull of a Roach.

The Skull also hath a Cavity (passing between the Eyes) made up of many bony Processes fortifying the Compage of the Skull, which is outwardly covered with a Skin, and more inwardly lined with a brown clammy substance.

The Cavity of this Skull.

The Skull of a Bream hath a bony frame most protuberant in the middle, and is composed of divers Processes (making their progress in length) which do much strengthen the fabrick of the Skull.

The Skull of a Bream and its Compage.

The Skull of a Basse hath a very thin and bony substance, beautified with a Pyramidal Figure, being broader near the *Occiput*, and afterward groweth narrower, and narrower ending in a Cone near the Mouth, and is adorned with two Sutures, seated about the edges of the Skull.

The substance of the Skull of a Basse and its Figure.

But the Skull of a Pike is composed of one entire Bone without any visible Suture, the outward surface is flat, and the inward hath two large Cavities, containing a transparent glutinous Matter, and the lower region of the Skull is engraven with many Cells as so many repositories of the Brain.

The Skull of a Pike.

The Skull of a Trutt hath a long flat Surface outwardly in every part, except in the middle, where a Protuberance passeth all along from the *Occiput* to the Anterior part, it is broad in one Extremity, and groweth narrow in the other till it endeth in a thin edge.

The Skull of a Trutt.

The Skull of a Fireflaire is rather Cartilaginous than Bony in reference to its substance, except in the middle, where it is framed of a tough membranous Matter, about a quarter of an inch broad in some part, and almost half an inch in the other; This Skull hath a Convex Surface without, and Concave within, running almost the whole length of the Skull between two Protuberancies, which are perforated in divers places for the ingress and egress of the Blood-vessels.

The Skull of a Fireflaire.

The Skull of a Sea Turtle is endued with a beautiful structure, as composed of many hard Shells, of which the greatest is seated in the middle, all beset round about with many small ones (adorned with variety of colours,

The structure of the Skull of a Sea Turtle, &c.

The substance
of the Skull
of a Kingston.

lours, shapes, and sizes) all tied together with many strong Ligaments. The Skull of a Kingston is made of a bony substance, whose outward substance is plain in every part, but the inward is even only for a small space in the middle (having a thin Process on each side) in which some part of the upper region of the Brain is lodged, as in Trenches, guarded also with two other Protuberancies, which are larger toward the Nostrils, and smaller on each side of the upper region of the Brain.

The Skull of
a Flounder.

The Skull of a Flounder is also bony, running through all the middle of the outward Surface; on each side of this Protuberance is seated two narrow oblong Cavities, but the inward Surface is bedecked with many small hollowneses and asperities.

† T. 29. F. 2.
a a.
† T. 29. F. 2.
b b.

The Skull of a Cod in its upper Region is engraven with divers Prominencies and Cavities; The Protuberancies are many, one of which is a Ridg (running in the middle of the Skull †) endued above with a thin edge, and below with a broader base, and terminates into a thin Sword-like Bone †, being a fine transparent expansion (ending into a point) butting out an inch and half beyond the *Occiput*.

† T. 29. F. 2.
c c c c.

On each side of the Ridg, is placed a Cavity † (where the Skull is thin and transparent) beset with many oblong Creces; And these Cavities do end

† T. 29. F. 2.
d d.

into two pointed Processes †, seated on each side of the Sword-like Process.

† T. 29. F. 2.
e e e e.

The creced Cavities are garnished in the middle with an edge-like Bone, and on each side with two thin Processes † (which may be stiled lateral) conjoined to the Region of the middle Process, and are carried on all along the sides of the Nostrils, which are guarded with two wing-like Processes † (seated under the Nostrils) made up of bony Fibres, passing cross-ways, and seem to be parted with many Creces.

† T. 29. F. 2.
f f f f.

The thin lateral Prominencies, are secured with two more strong and thick Processes †, placed under them, and do terminate into mammiforme Processes †.

† T. 29. F. 2.
g g g g.
† T. 29. F. 2.
h h.
† T. 29. F. 2.
i i.

The Base of this Skull is guarded with an oblong Column, fortifying it †, lest it should be broken in violent motions of the Head, or by the reception of some large Fish into the Cods Mouth for aliment.

C H A P. XXX.

Of the Diseases of the Skull, and their Cures.

THe Skull (being the Head-piece of the Brain to secure its choice Compartment) is made up of many Bones mutually locked in and set together by various Sutures, as so many fine and strong Articulations peculiar to the Skull, which is obnoxious to many wounds, of which every one admitteth variety of kinds.

The most General Wounds are Five in number, called by the *Latines*, *Fissura*, *Contusio*, *Ossis depressio*, *Sedes*, and *Contrafissura*.

The five wounds of the Skull.

The First is described by *Hipocrates*, *de Capitis Vulneribus*, after this manner, ὅστις ἐν ῥήγνῃ πρὸς τὸ κεφάλαιον, ἢ πρὸς τὸ στήθος, ἀνάγκη φέρεται περὶ τῆς ὀφθαλμοῦ: *Os sub vulnere finditur, ossiq; rimam habenti siquid fissum fuerit, Collisionem accedere necesse est.*

A Fissure of the Skull is produced by some heavy blunt Weapon, or by a fall against some hard Body, or by a Stone, a piece of Timber, or the like, by which the natural unity of the Skull is violated, as parted by a fracture into two or more Bones, which keep their natural situation in reference to depression.

The cause of a Fissure.

This Fracture hath many kinds, some broad, or narrow, others long or short; some crooked or straight, others superficial or deep; some Fractures penetrate only one Table, and others the *Meditullium* and both *Laminae* of the Skull.

The various kinds of Fractures.

In order to discover whether both Tables are broken, the Patient may stop his Nostrils, and shut his Mouth, and make a strong expiration, whereupon the detained Breath will have recourse to the Brain and swell up its substance and Membranes, whereupon will ensue an Exudation of a frothy Moisture, and sometimes of Blood, or sanious Matter; so that the manner of the Fracture may be discerned when the Skull is laid bare, which is necessary in wounds of the Skull.

The manner how to discover a Fracture.

After the Scalpe is removed from the Skull by the incision of the Muscular Skin and *Pericranium*, which must be divided from the Skull, else proper Medicines cannot be applied, and presently after this Chirurgical Operation hath been celebrated, Medicines must be administered to stop the immoderate flux, which often happens in this case, and requireth the assistance of a Skilful Chyrurgeon; and if the Skull be broken into small pieces, they must be taken away with proper Instruments, as not apt to be healed.

The Skull is to be laid bare in wounds.

If the Skull be broken, so that it is necessary either to be Trepaned, or lifted up, being depressed, or to be scraped in some case, the *Pericranium* must be removed from the Skull, which (as being fixed by numerous Membranes) is hardly effected, and accompanied with great pain, as being a Nervous part, endued with most acute sensation; whereupon to prevent an Inflammation and other severe accidents, Anodynes are to be applied, and a digestive immitted into the wound, made of the Yolke of an Egg, and Oyl of Roses, with this Caution, That no moist Medicine do affect the sound part of the Bone, but rather drying Medicines which do Conserve it, in

The Trepan is to be applied in wounds of the Skull.

in absorbing all superfluous and extraneous moisture, which rendereth the Skull obnoxious to be corrupted and carious.

A care must be had in the application of the Trepan lest the neighbouring parts be wounded.

And the Trepan being applied in a Fracture of both Tables, a great care must be had, that the *Dura Mater* be not wounded; And it is also worth our consideration, how to demean our selves, when a great flux of Blood (ariseeth from a broken Vessel, adhering to the inward *Lamina*) which must not be immediately stopped, but be permitted to flow some time, as far it is consistent with the strength of the Patient, to prevent a Fever, Inflammation, pains, and other ill symptoms.

The application of the Trepan being very troublesome, it may be demanded upon what account it is celebrated; to which I take the freedom to make this reply; First, That the depressed Bones in great Fractures of the Skull may be reduced to their former situation; Secondly, To discharge the extravasated Blood falling upon the *Dura Mater* in great wounds of the Skull, when the inward or both Tables are broken, and the Blood-vessels lacerated; and that the Sanious Matter may be evacuated, which often happens in Contusion of the Coats of the Brain.

Thirdly, the Trepan is used to lay open the wounded inward parts, the *Dura* and *Pia Menynx*, to see how they are affected, and that they may have Medicines immediately administered to them.

The Blood is not immediately to be stopped upon the application of the Trepan.

When the flux of Blood hath been sufficiently permitted upon the application of a Trepan; to hinder an Apoplex, Fever, and other accidents, Medicines may be advised to stop the flux of Blood made of the Powder of Aloes, Frankincense, Mastick beaten up with the Whites of Eggs, and the Hairs of a Hare cut into most minute Particles.

After the flux of Blood is stopped, the Searchcloth of *Vigo* may be used, as good in Fractures of the Skull, by reason it is attractive and made up of resolving and drying Ingredients; which being of a fragrant smell, do refresh the Brain, and also are endued with other qualities, which do corroborate it and its Membranes.

Drying Powders are proper in the Fracture of the Skull. The second wound of the Skull called *Contusio*, is described by *Hippocrates*.

Powders of a drying nature, or a corrosive nature may be used to the Skull, as Aloes, Frankincense, Dragons Blood, Mastick, Myrrhe, &c.

The second wound of the Skull is called by the *Latines*, *Contusio*, by *Hippocrates* φλάσις, and is described by him after this manner in his *Tractat. de Capitis Vulneribus*.

φλάσις δ' ἐν τῷ ὀστέῳ ἐν τῇ ἐσωτὲρ ὀστέῳ, καὶ ῥωγμὴ τῇ φλάσει ἔκ αὐτῆς ἀναστάντι πρὸς ὀστέον οὐδεμίαν. δευτέρου ἔστος. ἰδέαι δὲ τῆς φλάσιος πλείους γίνονται. καὶ ῥ' ἄλλων τῶν καὶ ἡσίων φλάσις, καὶ ἐς βαθυτέρην τὴν καὶ διὰ παντὸς τῶν ὀστέων, καὶ ἐπὶ πλείον τῶν καὶ ἐλαττον μακρὸς τῶν καὶ πλατύτετος. ἀλλὰ τετέων ἥνδε ἰδεῶν ὁδεμία ἐστὶν ἰδὼν τοῖσιν ὀφθαλμοῖσιν γινώσκειν, ὅτις ἐστὶ τὴν ἰδέην, καὶ ὅποση τὸ μέγεθος. ἐπεὶ ῥ' εἰ περὶ αὐτῶν, ἵοντων, περὶ αὐτῶν καὶ τῶν κακῶν γινώσκοντες, γίνονται τοῖσι δὲ φλάσι κατὰ φάσεις ἰδεῶν αὐτῶν μετὰ τῶν τρώων ὡς περὶ ἐδὲ ῥ' ῥωγμῶν ἥνδε ἔχουσιν καὶ ἑρρογόντος τῶν ὀστέων. *Contundi autem Os potest, Osse naturaliter se habente, ut & rima nulla ad ossis contusionem accedat, atque hic alter modus est: At Contusionis plures sunt formæ. Nam plus aut minus, & altius per totum Os contusio perwadit, aut minus alte, neq; per totum Os & ampliore aut minorem, tum longitudinem, tum latitudinem occupat. Sed nulla earum qualinam specie, aut quanta magnitudine existat, Oculis dijudicari potest. Namque enim ubi quid Contusum est, & malum accessit statim*

statim sub ipso vulnere Contusio oculis est Conspicua, ut neque rimæ quædam, quæ procul a Fisso Osse longius excurrunt.

A Contusion of the Skull is made by a Collision of one hard Body (violently encountering another) wherein the outward Surface remaineth entire according to Sense, and the inward position of Parts, receiveth an alteration, whence the Bone is forced more inward, and its parts are lodged more close and contracted; so that there seemeth to be Two kinds of Contusion in the Skull; The one is when the more outward parts have a recourse inward, not admitting a change in the Figure of their Surface; The other is when the outward Table is depressed, and loseth its former Situation and Form, by obtaining a Cavity or Trench, which is the Third kind of wound relating to the Skull, of which I intend to Treat hereafter.

The cause of a Contusion of the Skull.

The kinds of a Contusion.

The First kind of Contusion is found in the soft part of Skulls, and chiefly in those of Children, who are endued with a more moist and loose Compage of Bones, and the more solid frames of Skulls of Men have a spongy substance lodged between the two Tables, which is receptive of compression, and may have its parts more closely brought together, and affected with a Contusion, which being acted with violent ill accidents, is sometimes accompanied with the laceration of Vessels; whereupon extravasated Blood is lodged in the inward Recesses of the Skull, and rendreth it carious.

The Third kind of wound belonging to the Skull, is called by the Latines *Depressio*, and by *Hipocrates* ἑσφλάσις. As he hath it in his Book *De Capitis Vulneribus*. ἑσφλάσις τὸ ὅτεον ἐκ τῆς φύσεως τὸ ἐσωτὲς ἔσται σὺν ῥωμῆσιν, ἀλλὰ γὰρ ἐκ ἀν' ἑσφλάσεως, τὸ γὰρ ἑσφλάμενον, ἀπὸ τῆς φύσεως τῆς φύσεως, καὶ κατασφύμενον, ἑσφλάσις ἔσται ἀπὸ τῆς ἀλλῆς ὅτεον ῥωμῆσιν ἐν τῇ φύσει τῆς φύσεως. καὶ διὰ τὴν ῥωμῆν ἀν' ὡς οὖν τῇ ἑσφλάσει. τρεῖς ἔσονται τρεῖς. ἑσφλάσει ὃ τὸ ὅτεον πολλὰς ἰδέας, καὶ ἐπιπλέον τὸ ὅτεον καὶ ἐπ' ἐλάσσον, καὶ μέλλον τε καὶ ἐξ βαθυτέρου καὶ τὸ ἥσσον τε καὶ ὀλιγοχρόνιον.

The Third kind of a wound, called a Depression of a Skull.

Os medium desidit, ubi a Natura sua intro recedit, una cum rimis, alioqui medium non desideret; quod enim medium desidit, ab alio Osse naturaliter se habente abruptum fractumque introcedit, itaque sane huic casui rimam accedere necesse est. Atque hic tertius est modus. Multis autem modis os medium desidit. Namque hoc majorem & minorem ossis partem occupat, aut magis & altius ad imum penetrat, aut minus, & in superficie extat.

This kind of fracture of the Skull, named Depression, is different from that of a *Rima*, by reason it changeth its place, as the Bones of the Skull are beaten inward, and receive a Cavity or Furrow, which is not visible in *Rima simplici*, wherein the surface of the Skull retaineth the same equality of surface, with which it was invested before the Fissure.

And this wound of the Skull doth not suppose only an Introcession of it, but is attended with a Fracture, wherein the natural union of the Bones is violated, and is sometimes accompanied *Cum Fissura*, and other times *Cum Sede*.

The depressed Particles of the Skull being protruded inward, have sometimes one or more fragments, or shivers, gauling the tender Compage of the *Dura Mater*, which now and then happens, but is not a requisite condition to constitute a depression of the Skull, which may be produced by a violent fall or stroke against some hard body or weapon, dashing the broken Skull inward, without any violence offered to the neighbouring Membranes of the Brain.

In order to help the depression of the Skull, when it is broken into divers Particles, sometimes the *Trepan* may be applied, to let out the putrid or sanious Matter lodged near the Brain, and other times the shivers of the Skull may be removed by *Vestes*, or *Forcipes*, lest they should offend the tender Coats of the Brain; with this caution, that as little of the Skull as

A Trepan may be administered in the Depression of a Skull.

may, be taken away, by reason it is instituted by Nature, to guard the Brain from cold, and ill outward accidents.

An instance of
the Cure of
the Depressi-
on.

Learned *Paræus* giveth a History of a Servant, whose Skull was broken by the kick of a Mule, and being depressed, was lifted up by the application of the *Trepan*, and the Matter lodged under the Skull discharged; and some part of the broken Skull being removed, the Patient was restored to his former Health. As this Learned Author hath it *De partium vulneribus, lib. 9. Pag. 274. Ejus rei nuper patuit veritas in seruo, D. Groto gravi Mulini Pedis Calcitratu effracturam in Coronali Osse passo: Id ipse cum intelligerem, trigona sectione cutem Musculosam eo consilio parte illa divisi ut terebram liceret ad-movere, sequente die ergo terebrato osse, cum de illo extrahendo cogitarem, imò ipsum jam terebra divisum avellere Conarer, enormem effracturæ productionem, ex Ossis sub manu vacillantis mobilitate cognovi: a medio enim fronte usq; ad minorem oculi Canthum protendebatur. Itaq; extrahendi & consilio & conatu misso agro satisfactum putavi, si Os ipsum depressum erigerem altius: sic enim non jam crassæ meningi comprimendo molestum erat, & conclusis materiabus per divisionem serra factum exitus patebat; quo factum est, ut tandem convalesceret, nisi quod inde altero lumine, quod ad fracturam orbatus est.*

The Fifth
wound, cal-
led *Sedes*.

The Fourth kind of a wound of the Skull is styled by the *Latines*, *Sedes*, by *Hipocrates* ἑδρη, which he deciphers in his Book *De Capitis vulneribus*.

καὶ ἡδρη ὁνομαζέσθαι ἐν τῷ ὀστέῳ βέλεος, περιήρτοι ἀν' ῥωγμὴν τῇ ἐδρῇ, τῇ τε ῥωγμῇ καὶ φλάσιν περιήρτοι ἀνα-
κλινόντες, ἢ μᾶλλον, ἢ ἥσσον, ἢ ἡπερ καὶ ῥωγμὴ περιήρτοι ἐνθάπερ καὶ ἑδρη ἐχέσθαι, καὶ ἡ ῥωγμὴ ἐν ᾧ ὀστέον τὸ
περιήρτοι πῶς τε ἐδρῶν καὶ πῶς φλάσιν τέτυκτος ἕως τέρους καὶ ἑδρη δὲ τῷ βέλεος γίνεται ἐν ᾧ ὀστέον, ἑδρη δὲ
καλεῖται ὅταν μόνον τὸ ὀστέον ἐν τῇ ἐκείνῃ φύσει τὸ βέλος σπείζαν ἐς τὸ ὀστέον δὴλον ποιήσῃ ὅπῃ ἐπέειξεν.

Ac ubi telum in Osse vestigium reliquit, utique rima adjici poterit, & ad rimam collisum aut magis aut minus accidere necesse est, cum qua etiam parte rima accessit eadem teli vestigium appareat & rima sit in Osse qua teli vestigium in Osse remanet. Teli autem Sedes dicitur, cum Os suo statu permanens manifestum fecerit qua telum infederit.

This wound of the Skull is made, when the weapon, or any other hard, sharp Body, leaveth a plain impressiion in the cut Skull, which always is conjoyned with the Incision of the Scalpe and *Pericranium*.

The First
kind of *Sedes*.

In this case the Skull is many ways offended, First, when a simple wound is inflicted by a Sword, Knife, or the point of any sharp weapon, whereby the Skull is wounded, and a Puncture produced, not only penetrating the First Table, but the Second too; and if the Skull be cut with a sharp weapon (which is the Second kind of *Sedes*) according to the length of it; so that the wounded Skull is not disordered according to its situation, it may be called Incision, as the print of the weapon remaineth in the cut Bone, sometimes affecting the First Table, and other times the Second.

The Third
kind of *Sedes*.

The Third kind of a *Sedes*, discomposing the Skull in the unity of parts, when some part of the Bone is cut off and lost, which the *Greeks* call διακομή, καὶ ἐκκομή, and the *Latines* *Dedolatio* sive *excisio*, wherein the Skull is shaved in some part, after the manner as a Trencher or Borde hath its Compage made more thin by a Plane.

The Fourth
kind of *Sedes*.

The Fourth kind of *Sedes* is a kind of compound wound, wherein not only part of the Skull is cut off, but is attended also with a Fissure too, as the wound is made by a weapon somewhat blunt in its edge.

The Cure of a
Sedes.

As to the cure of this Disease it may be observed, that if some part of the Skull be cut off, and hang only to a little of it, or to the *Pericranium*, and *Muscular Cutis*, it is not to be parted from them, but to be reduced to its proper

per situation; whereupon it will be agglutinated to the Skull, by the apposition of a clammy, or callous Matter, uniting them to each other; as Learned *Celsus* an antient Chyrurgeon hath well observed, which *Paræus* hath confirmed by his experience, *Cap. 9. De partium vulneribus*, Pag. 274. *Hujus rei veritatem certa experientia in capitaneo Hydron non ita pridem comprobavit. Illi Ossis Coronalis portio media tres digitos longa, lataq; ense valido sic excisa erat, ut jam vicinæ ossæ non cohereret, sed vix pericranio & cuti musculosæ adhærens in faciem inversa procumberet, ac crassam meningem oculis subiceret, itaque ipsam a sua cute revulsam paravam adjicere, in Hipocratici illius præcepti in mentem venisset, quo tantum est cerebrum operculo suo exarmare, & nudum relinquere. Quare sanguinem qui in crassam meningem, cujus motum oculis erat percipere, exciderat primo quoque tempore absterse, ossis prozolutam portionem suo loco reddidi, & ex superna parte Sutura, tribus punctibus adaucta acu, stabilivi: atq; quod reliqua saniei pateret effluxus, interjectas vulneris rimas, linamentis complevi: Hac arte factum est, ut etsi eodem illo tempore multis aliis & ingentibus vulneribus Corpus confossum haberet, per Dei tamen misericordiam convaluerit: exemplo certissimo nihil neq; Cranii, neq; Pericranii, ac ne Musculosæ quidem Cutis quidquam nisi poscente necessitate abjiciendum, multo vero minus ut cerebrum suis operculis nudum maneat committendum.*

The Fifth kind of the wound of the Skull is called by the Latines, *Contra-fissura*, when it is made in some opposite place to the stroke, or fall, and is described by *Hipocrates* in his Book *De Capitis Vulneribus*, after this manner,

The Fifth kind of a *Sedes*, called *Contrafissura*.

Ὅσον πρῶσταται ἄλλη τῆς κεφαλῆς ἢ τὸ ἑλκος ἔχει ἄνθρωπος, καὶ τὸ ὁρῶν ἐν ἑλκώσῃ τῆς σαρκὸς. Πέμπος ἔστι τῆς πρὸς, καὶ ταυτὶ τὸ ἐνυφορῶν ὅταν γῆνηται, ἐκ αὐτοῦ ἐχόντι ὁφελῆσαι ἑδέν. ἑδὲ γὰρ εἰ πέπονθεν τὸ κακὸν ἔστω ἐκ ἐστὶν ὅπως γῆν αὐτὸν ἐξελεγξάντα εἰδέναι εἰ πέπονθεν τὸ κακὸν ἔστω ἄν ἄνθρωπος, ἑδὲ ὅπῃ τῆς κεφαλῆς. *Os sub vulnere frangitur alia capitis parte quam quæ ulcus est & Os nudatum est. Quintus hic modus est. Huicq; calamitati nullis remediis subvenias. Neque enim ubi istud contingit quam ratione istud homo patiaturs aut quam Capitis parte ex ejus percunctatione deprehendas.*

The Great Master of our Art calleth it *Ἐνυφορῶν*, *Infortunium*, and denoteth those surpris'd with this Disease to be unfortunate, as being ignorant of the seat of their malady; whereupon the Physician is left in the dark, till the Disease having got too great a head, becomes incurable.

Learned *Sennertus* giveth this account of it, *Accidit autem contrafissura ex resultu ictus in partem a plaga distantem, & ad resistendum minus aptum. Dum enim aer in diploe vocata, hoc est in Meditullio Cranii, seu inter utramque laminam, conclusus vehementer ex ictu alterius loci agitur & impellitur undique fit, ut loco alter Calvæ solidæ allisus ipsam perfringat.*

This Disease admitteth diverse kinds, The First may be when the Bone struck and wounded, being seated in different places in a *Contrafissure*, happens to be both in the same Bone.

The diverse kinds of a *Contrafissure*. The First,

The Second kind is, when the outward Table being struck, remaineth sound, and the inward is wounded.

The Second,

The Third is, when the struck Bone is parted from the wounded by some Suture.

The Third kind.

The Fourth kind of a *Contrafissure* may be, when a blow being inflicted upon some part of the Head, and the Blood-vessels of the *Dura* or *Pia Mater*, are wounded in a place distant from the blow, which being given against the hinder part of the Skull, hath broken the vessels seated in the anterior part of the *Dura* or *Pia Menynx*, causing a Flux of Blood to be discharged through the Nostrils.

The Fourth kind of a *Contrafissure*.

Having

The Prognosticks relating to the wounds of the Skull.

Having given a description of several kinds of Diseases relating to the Skull, it may seem not improper to shew their Prognosticks, which may be of great use to arm our selves, with a true Prognostick, when we cannot make a Cure, which speaketh our Skill, and giveth satisfaction, that we are not mistaken in the knowledge of the Disease.

The wounds of the Skull, as being an Integument of the most noble part of the whole Body, do threaten great danger, as often affecting the Membranes and substance of the Brain.

A small Fissure of the Skull is very dangerous.

The wound of both Tables is often fatal.

The danger is less when one Table is wounded, and greater when both are divided, and when the Fissure is small it hath most of danger, and less in a *Sedes* when the wound is broad and not deep, without any Contusion or Fissure; which when made through both the *Laminae*, is attended with a Flux of Blood (coming from the lacerated vessels) falling down upon the *Dura Mater*, often productive of an Apoplexy, from compressing the Origins of the Nerves, and intercepting the Influx of animal Liquor.

The fracture of the inward Table is sometimes accompanied with shivers of the Skull, which do prick the Coats of the Brain, and produce dreadful symptoms, which prove very fatal, especially if the fragments of the broken Skull do penetrate the substance of the Brain.

In hidden Fractures and Contusions, the *Meditullium* is often wounded, and its vessels broken; whereupon it is filled with extravasated Blood, which putrifies and corrupts the Skull.

Wounds are dangerous in the Sutures, in reference to the weakness of the Skull, and by reason some part of the *Dura Mater* is fastned by Fibrils to the Interstices of the Sutures.

Divers dangerous Diseases follow the depression of the Skull.

Depressions of the Skull are not safe, because there is but a little space between the Skull and the Brain; whereupon it being compressed, is often engaged in ill accidents, which are of Two kinds, which follow the affections of the substance of the Brain, and its neighbouring parts, as a Convulsion, Palsy, *Sopor*, *Stupor*, *Delirium*, and a Fever.

A Second kind of Symptoms is less terrible, and follows the commotion of the animal Liquor and Spirits, whence Patients are deprived of their Speech, Hearing, and Sight, which often return without any great prejudice.

The ill symptoms of the wounds of the Skull.

Accidents coming in the beginning of wounds of the Head, as pain of the Head, and bleeding of the Nose, or the disturbance of the animal Spirits are not deadly; and ill symptoms arising about the state of the Disease are worse, by reason they denote a collection of *Pus* or sanious Matter, &c. And if a Fever doth appear about the Fourth or Seventh day, it proceedeth from the generation of *Pus*, and if the Fever happens after that time, it may have a more sad consequence, as denoting the corruption of the coats or substance of the Brain.

If the lips of the wound be hard and dry, somewhat resembling salted flesh, as also depressed without any Tumor, or sanious Matter, or *Pus* coming out of the wound, it portends great danger.

If the Bone groweth Black in the beginning it is deadly; and very dangerous in wounds of the Skull to have Pustles in the Tongue and Mouth, which are symptoms of ill and malignant Fevers, attended with a *Delirium*, a lost Memory, *Stupor*, loss of Sight, Hearing, and sometimes with a Palsey, or Convulsive motions, which often speak a period to Life.

C H A P. XXXI.

Of the Dura Menynx.

THUS I have shewed you the prospect of the out-building, and the choice Hangings, and rich Furniture of the inmost Chambers of the lower and middle story, which are *Chameras*, and *Anti-chameras*, leading to the highest Apartment of the elegant frame of humane Brain.

And afterward I intend to give you also a History of the progress of the Animal Liquor, how it associateth with the Chyle, exalting it in its several local and intestine motions through the Ventricle, Guts, Mesentery, and thoracick Ducts, and how the Animal Liquor entring into an intimate Confederacy with the Blood, enobleth it in its Circuit through the Kidneys, Spleen, Liver, and the Chambers of the Heart, and passage through the Lungs; as also through the common and ascendent Trunk of the *Aorta*, which lead into the Carotide Arteries, climbing up into the highest story; where my purpose at this time is to give you a description of the fine Vestments, and rich Householdstuff of this most excellent Apartment, and the Origen, Substance, Uses, and action of the Coats, Cortex and elegant Processes of the Brain, and where, how, and of what the Animal Liquor is generated, and propagated through the several Processes of the Brain, into the Nerves, as so many elongations, and outlets of it, made for the exercise of the rational sensitive and motive Powers and Functions; and what proportion or disproportion the Coats and Processes of more perfect or imperfect Animals hold with that more noble Fabrick of Humane Brain.

And that we may proceed methodically, we will first Treat of that part which is first in order, of the upper Robe of this gallant Body of the Brain, the *Dura Menynx* † of which I will take the freedom (with your leave) to consider the structure made up of nervous and carnous Fibres, and other Vessels, and various minute Glands, confining, and seated on the upper and under surface of the *Dura Mater*; as also the Connexion, Situation, and Perforations made by Vessels; and its Origen, and its Insinuation into neighbouring parts, its Duplicature, and several *Sinus*, and concurrence of them. And last of all, the Functions and Pathology of it. And First I shall endeavour to give you my meaner Sentiments, of the nature and composition of this fine upper covering of the Brain, relating to the curious Texture of it.

Some are of an opinion, that no proper constituent parts can be attributed to this Membrane, but it must be content for its Texture, with the common Vessel, with the divarications of Arteries, Veins, and Nerves, which doth seem according to my apprehension, not to comply altogether with Reason, because if the *Dura Menynx* should be primely made up of Arteries and Veins, they would lose their use of importing and exporting Blood into, and out of the Brain upon this account: because these Vessels being Tubes, if they should be brought by compression into a Plain, as they must be necessarily in framing the close Texture of this Membrane, which cannot be effected, unless the Vessels be nearly struck one to another, whereupon the current of the Blood will be intercepted, and tumefy the Vessels, causing an Inflammation; so that I humbly conceive, the Arteries and Veins to be

† T. 46. F. 1. 66

The parts to be Treated on concerning the *Dura Mater*.The *Dura Mater* is not only composed of Blood-Vessels.

no proper Integrals, entring into the substance of the *Dura Menynx*, being not the proper Matter of which it is compounded, but do only expatiate themselves upon, or between the Coats of the *Dura Mater*, where they sport themselves in greater or less Divarications; whence I may plainly inferre, that this Membrane is not intimately framed of the common Vessels of Arteries and Veins, but doth challenge to it self a more peculiar Compage, which I do apprehend to be made up of an innumerable company of membranous and nervous Fibrils, not only dispensed from the Nerves, issuing out of the substance of the Brain, but also originally produced out of the more tough part of the seminal Liquor.

The nervous Fibrils are proper Ingredients of the *Dura Mater*.

The progress of the nervous and membranous Filaments.

These nervous and membranous Fibrils are most minute Filaments finely spun, and passing long-ways the whole length of the Membrane, from the fore-part to the hinder, make the Warp, and other Filaments running cross-ways, and intersecting these right Fibres from one side to the other, may be called the Woof; so that those numerous small Filaments of the Warp and Woof do frequently decussate each other, and being close struck do seem to be one entire substance, which is indeed a contexture, made up of innumerable minute Fibres, close put together by a most skilful hand.

The *Linea Alba* is a contexture made up of diverse tendinous Fibres.

The *Linea Alba* being a thick Membrane, framed in like manner of divers tendinous Fibres, mutually intersecting each other, and so closely united, that they appear to be one uniform substance.

The Brain of a Fish covered with a company of minute Filaments.

A Learned Physician told me, that in a Body Dissected at Chyrurgeons-Hall, the *Linea Alba* was wanting, and supplied only with a multitude of Filaments, crossing each other in acute Angles: Whereupon in Analogy, we may easily be drawn into belief, that Membranes are curious Contextures, formed out of numerous membranous, and nervous Threads, mutually intersecting each other, and so nearly conjoyned, that their closings one with another cannot easily be discerned, except when Nature hath not well accomplished the Texture of these Fibres, as you have heard in the late instance of ill united tendinous Filaments, seen in a Body in the Chyrurgeons Theater; and to parallel this humane Instance in a more imperfect Animal, I have seen (in the Head of a Fish, being Dissected) some part of the Brain imperfectly covered with a number of minute Filaments, so ill put together, that I could very easily discover the Interstices of the ill interwoven small Fibres of the *Dura Mater*. And that a farther confirmation may be given of this Hypothesis, wherein the *Materia Substrata* of this Membrane is asserted to be a Systeme of well-composed nervous, right, and transverse Filaments, variously intersecting each other, else it cannot be well conceived, how a great extension of the *Dura Mater* can be made long-ways, except it be framed of right Fibres; nor broad-ways, except it be composed of transverse, both of which being capable of Extension, do preserve the *Dura Mater* from Laceration; else if it were wholly one entire substance, one part would start from another in violent motions, and suffer a great violation in the whole, rendring the *Dura Menynx* useless, and expose the Cortex to great inundations of Blood; Whereupon it being highly compressed, would intercept the entrance of the Animal Liquor, into the roots of the nervous Fibrils; thence causing an immediate Apoplexy.

The various Filaments in several positions, do strengthen the Compage of the *Dura Menynx*.

The *Dura Mater* is beset with car-nous Fibrils.

And further, it may be somewhat probable (as I conceive) that the *Dura Menynx* is not only made up of nervous, but also of some car-nous Fibres too, which are very small, running between the two Coats, and is near akin in this to the Membranes of the Gullet, Ventricle, and Intestines.

Those

These carnos Fibres take their rise near the Falciform Process, where their Trunks do arise, and running cross-ways, do insinuate themselves into the substance of this Membrane, and are divaricated into smaller and smaller branches, in the manner of a Tree, as they are carried in the Membrane nearer and nearer toward the Base of the Brain, which I plainly perceived in the Membrane, cut and turned up, and violently stretched out. And these minute fleshy Fibres run clean counter to the course of the Arteries, whose Trunks commence near the Base of the Brain, and are branched into more and more minute Ramulets, which are more numerous in their Capillaries, as they more and more approach toward each side of the Falciform Process, where they very frequently wheel, and then associate; and after a small space part again, making various Arches after the manner of Network; Among the minute Capillaries are interspersed many small Glands, seated on both sides of the Third Sinus, near the Trunks of these carnos Fibres, whose branches divide themselves in the substance of the *Dura Mater*, contrary to the progress of the Arteries; and are (as I conceive) the true cause of the motion of this Membrane in Sneezing, which is performed by the brisk Contraction of these carnos Fibres, expelling some sharp vapours, or thin serous, or more gross viscid Recrements, which give a trouble First to the *Dura Menynx*, investing the ventricles of the Brain; whereupon it endeavoureth to free it self from an importunate Guest, by making a great compression of the *Cortex*, and more inward Recesses of the Brain, thereby drawing other parts of the Body in to consent with it, which can hardly be effected by minute nervous Fibrils, not able to produce such strong agitations and concussions of the Brain, as are made in Sneezing, unless they be assisted by carnos Fibres, which are much fewer in number then the nervous, the great ingredients of the *Materia Substrata* of the Coats of the Brain.

Wherefore these nervous Fibres being so considerable, in reference to the Matter, out of which the *Dura* and *Pia Mater* are compounded; I shall endeavour to give a short account of the nature of them, upon which the action of Extension and Relaxation, and uses of the coats of the Brain are founded.

These nervous Fibres are minute, round, oblong Bodies, of a gluy tenacious disposition, and thereupon can easily maintain their fine Compag with each other, and being of a tough tensile nature, are apt to be lengthened and strengthened; and being of a pliable temper, can admit various Flexures without laceration, because these Fibres are of great strength, every single one being compounded of many Filaments so curiously clapped together, so closely conjoyned, by the interposition of most thin Membranes, that they seem to make up one entire Body.

And these Fibres being round, cannot be so closely united in all parts, but they must have some very small empty spaces, which are interlined with an Animal Liquor, which being somewhat consolidated, covereth the interwoven Fibres, crossing each other, else they would be easily discerned, were they not faced, and lined above and below with nervous Liquor, filling up the chinks of the Fibres, rendring their Compag plain, and even; and it were to be wished for, and by all means possible to be attempted, that by scraping, or frequent washing the Coats of the Brain, the Fibres might be freed from the concreted intercurrent Liquor; that the curious contexture of the Fibres might be discovered, which would afford a very pleasant prospect to behold Natures fine Architecture, speaking the great contrivance of that All-wise, and most Glorious Mind.

The rise of the carnos Fibrils.

The progress of carnos Fibrils.

These Fibres run Counter to the Blood vessels.

Many minute Glands are placed among the capillary Vessels, near the Third Sinus.

The Carnos Fibres of the *Dura Menynx* are a cause of its motion in Sneezing.

The description of these nervous Fibrils.

The Parenchyma of the *Dura Menynx*.

The serous
Vesicles of
the Dura Me-
nynx.
† T. 46. F. 1.
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In the inside of the *Dura Mater* in a Humane Brain, I clearly saw some Vesicles † tumefied with serous Liquor commixed with Air (rendring it a very transparent substance) near the Falciform Process; where I discovered a great company of minute round Glands, affixed to the inward Surface of the *Dura Mater* near the Sith-like Process, confining on the upper part of the long *Sinus*.

The orbicu-
lar Glands of
the outward
Surface of the
Dura Mater.

And also in the Anterior part of the *Dura Menynx*, not much distant from the middle of the Falciform *Sinus*; I manifestly saw many more small orbicular Glands, besetting the outward surface of the *Dura Mater*, seated on the margent of the Falciform Process.

The *Dura*
Mater cover-
eth the Ce-
rebellum.

The *Dura Mater* also insinuateth it self between the lower region of the Brain, and investeth the *Pia Mater*, immediately covering the *Cerebellum*. Hereabouts the Duplicature of the *Dura Menynx* is very visible near the Margent of the *Cerebellum*, where the skirts of the *Dura Mater* are dressed more or less all round the tower of it (between the two Coats) with Glands adorned with a kind of an orbicular form, and different sizes.

The Glands
are seated be-
tween the
Dura and
Pia Menynx.

So that the *Dura Mater* both above and below, in the various surfaces of it, investing the *Pia Mater* seated in the upper region of the Brain; as also the *Cerebellum*, with a company of small Glands, the Colatories of the Blood, and its serous Juyce, the *Materia Substrata* of Animal Liquor.

† T. 46. F. 1.
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The Skull being taken off, the First objects that accost our sight, are the Membranes of the Brain, commonly styled the *Dura* or *Crassa*, † and the *Tenuis* or *Pia Menynx* every way encircling the Brain, as with finer vessels, through which, as through thinner clouds its beauty is transmitted to the Eye, made more greedy and apprehensive through the weak restraints, under which we may discover a glimpse of a fine Landscip, made up of various rivulets of Veins and Arteries † branched within the Coats in a Doe, and upon the surface of the Cortex, which is beset with divers vesicles of serous Liquor (impregnated with Air of different shapes and sizes) beautified with divers unevennesses of rises and falls, seated in the *Anfractus* †, resembling so many minute Intestines, passing backward and forward in various Mæanders, the allodgments of Vessels.

The Blood-
vessels of the
Dura Mater.

† T. 46. F. 1.
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The serous
vesicles of it
in a Doe.

† T. 46. F. 1.
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The *Anfra-
ctus* of the
Brain resem-
bled the In-
testines.

The *Dura*
Mater is seat-
ed more
loose then the
other Coat.

The upper vest of the Brain is more free and loose then the other, except where it is fastned to it, and filleth up every Cavity of the inward Surface of the Skull, except the *Sinus* of the *Os Cuneiforme*, in which the *Glans Pituitaria* is lodged, and the *Sinus* designed for the reception of the Branches of the *Carotis Interna*, climbing up the sides of the *Glans Pituitaria*.

The Situation
and Connexi-
on of the *Du-
ra Menynx*.

The *Crassa Menynx*, or outward veil of the Brain, is situated immediately under the Skull, its Convex being contiguous to the Concave Surface of the Skull, and is fixed to the *Pericranium*, by membranous Fibres and Vessels transmitted to it through the Sutures, and is conjoynd inwardly in its Concave Surface to the *Pia Mater*, by the interposition of Veins and Arteries, communicated from the thicker to the finer Membrane of the Brain.

The Perfora-
tions of the
Dura Menynx.

It admitteth several Perforations for the conveyance of Arteries, Veins, and Nerves to the neighbouring parts, and giveth way in the bottom of the Head to the *Infundibulum*, and *Spinalis Medulla*, where it entreth into the *Vertebres* of the Neck.

The Perfora-
tions of the
Dura Menynx.

It is compounded of a double Membrane, the inward more White and Smooth, and the outward facing the Skull, is more rough, by reason of Fibres, by which it is joyned to it.

The Perfora-
tions of the
Dura Menynx.

Perhaps some may be so curious as to pry into the Origen of this Membrane, of which Divine *Hipocrates* giveth this elegant account, in his

The Origen
of this Mem-
brane, accord-
ing to *Hipo-
crates*.

Book

Book Πίει ἀρχὸν ἐκ κεφαλῆς ὅπ' ἐλίσσον ἔχει τὰ λιπαρὰ, τὰ δὲ κολλώδεις πλεον, ἢ συνάπτει ἐκκαυθίσαι, ὡς τὰ δερμῆ, ἀλλὰ ἐν πρὸ χροῖα χροῖα, μένισσα παχύνει ἐλαβείν.

Cerebrum quum minimum habet pinguis, plurimum autem viscosi, a calido tumere nequeat, sed ductu temporis membranam, meningem crassam accepit.

The Opinion of our Great Master (I conceive) may be thus illustrated,

The illustration of the said Opinion.

The more refined Particles of the seminal Liquor, as most spirituous, do naturally tend upward; And as First in perfection, may truly challenge the most eminent place, the Apartment of the Body, in which the radical moisture being colligated by the ambient heat of the *Uterus* into a Crystalline Humor, at first representing limpid Water, the rudiment of the Brain. The more viscid part of the genital Liquor being unfit to form the substance of the Brain, is thrust out to the outward parts, where it groweth more indurate, till it is turned into a Membrane, to confine and preserve the more thin and fluid seminal Liquor, unable to govern it self, unless immured within the soft embraces of this tender Wall.

The *Dura Meninx* deeply insinuateth it self into the top and forepart of the Head, into the Interstice, of the Two Hemispheres, and descending toward the *Corpus Callosum*, and ascending again toward the Surface of the Brain, maketh an Ingemination, and is adorned with Two Processes, the upper one parteth the Right side of the Brain from the Left, running the length of the Head toward the Nostrils, and beginning in a deep Base, groweth narrower and narrower, till it terminateth into a blunt point, taking its Origin near the *Cerebellum*, and afterward groweth less and less, till it is inserted into the *Os Spongiosum*, commonly called *Crista Galli*.

The progress of the *Dura Meninx*.

This Process is styled by the Antients, *Falx*, as resembling a Sickle in Figure; upon this account, the hinder part of this Process representeth the broad part next the handle of the Sickle, and the forepart bounding upon the *Crista Galli*, is the point, the upper and Convex part resembleth the back of the Sickle, and the Concave the edge.

The Falci-forme Process. The Figure of the Process.

The hinder reduplication of this Process of the *Dura Mater*, is thicker and shorter then the fore, making a partition between the *Cerebrum* and *Cerebellum*; it being most thick in these places, to keep the *Cerebrum* and *Cerebellum* from dashing and compressing each other; and for this reason the Fence or party-Wall, that mediatheth between the *Cerebrum* and *Cerebellum*, in Dogs, Cats, Horses, Foxes, and many other Animals is bony, called *Os Triangulare*, to preserve those tender parts from offering violence to each other in great Concussions. This Membrane passing between the Brain and the Interstices of the *Cerebellum*, goeth down by one side, and climbeth up by the other, leaving certain doubles, which being closed only above, do form divers large Cavities within, commonly called *Sinus*: *Galen* calleth them *Meninges*, *διπλῶσις*, which Anatomists have described not to be orbicular, as other vessels, but somewhat depressed; and are Four in number, the Two first, (as they will have it,) are the lateral, which are founded in the short and hinder Process of the *Dura Mater*, and take their rise at the side of the hole of the first Bone of the *Occiput*, and climbing obliquely up, till they arrive to the Apex of the *Cerebellum*, where they associate with the Third and Fourth *Sinus*. The general concourse of all the *Sinus* is called *Torcular*, so first styled by *Herophilus*.

The use of this Process.

The *Sinus* of the Brain are Four.

The Two lateral *Sinus*.

The general Concourse of all *Sinus* into one, is called *Torcular*.

The Third *Sinus*.

Out of the association of these two lateral *Sinus*, and Two other, the First of them is named the Third *Sinus*, which passeth upward, and Fourth downward; The Third and largest of all the *Sinus* runneth through the middle

of the upper Region of the Brain, parting the Two Hemisphæres, and is carried the whole length of the Head, under the Sagittal Suture, and tied to the upper part of the *Os Ethmoeides*.

The Fourth
Sinus.

The Fourth *Sinus* is the most short of them all, and tending downward, descendeth in a straight course, between the *Cerebrum* and the *Cerebellum*, under the Base of the Brain, to the *Nates* and *Glans Pinealis*.

Having in some manner given you a prospect of the several *Sinus*, I shall endeavour to render you an account of their uses.

The uses of
the Sinus.

Vasorum structuram muneri huic obeundo designarunt Anatomici, ut venæ ab Arteriorum ductibus, membranis & cerebro latitantibus, sanguinem his refocillandis minus idoneum, recipientes in Sinus hosce exonerarent. Adeo ut Sinus illi eodem perfungantur penso quale vena Cava intimi corporis regioni elargiatur, ut sint Cisternæ quædam, magnorum canalium instar, ad quos minores venarum rivuli confluerent, sanguinis copiam regerentes: Atque eo nomine vasa illa ad domicilii hujus parietis abligavit Divinus ille Opifex, ne intimi tenerrimiq; cerebri recessus, copioso intumescerent sanguine, nimia distensione lacerentur, & ne mitior & delicata Spirituum Animalium æconomia, intestino sanguinis perfervidi motu exagitata functionibus animæ peragendis, prorsus inepta redderetur.

† T. 46. F. 1.
666.
The Arteries
of the Dura
Menynx.

The proper Blood-vessels † with which the *Dura Mater* is concerned, are either Arteries, the internal Carotides which import Blood into it, and the internal Jugulars to export Blood from it. As to the Arteries, two of them of the same side before they arrive the Base of the Brain, are dispersed into the *Dura Menynx*, branching themselves principally into the Convex-Surface of the Membrane; and some of them do insinuate themselves between the Tables and Sutures of the Skull, terminating into the *Periostæum* and *Pericranium*, the finer vails, that every way externally invest it.

The Veins of
the Dura
Menynx.

And as to the Veins, they export Blood from the Membrane, and carry it into the descendent Trunk of the *Cava*, and so into the Right Ventricle of the Heart.

The *Dura Mater* is furnished (as above described) with Four eminent Cavities, and many Branches, dispersed through the Membranes, and substance of the Brain, as those more spacious and venous Receptacles, and so many lakes, into which Veins the smaller Rivulets discharge their Purple Liquor, so that the Office (to which these *Sinus* are consigned) is to serve the Veins, as so many greater Channells, to reconvey Blood from the Membranes, and several regions of the Brain, to the Jugulars seated below it.

The manner
how the
Blood is con-
veyed out of
the Dura Ma-
ter into the
Sinus.

The upper *Sinus*, which by reason of its situation, and greatness, might be truly styled the First, but is called by the Antients the Third (which I will observe in respect to Antiquity, and for distinction sake) receiveth Blood immediately from the Veins of the upper part of the *Dura Mater*, and the Brain; and thence conveyeth it into the lateral *Sinus*, which being seated near the First Bone of the *Occiput*, and passing up obliquely to the Apex of the *Cerebellum*, receiveth Blood from it, and the hinder part of the Brain, by the interposition of the Veins. The Fourth *Sinus* extending it self between the *Cerebrum* and *Cerebellum* to the *Nates* and *Glandula Pinealis*, toward the Base of the Brain, receiveth Blood from the inward Recesses, and all the adjacent parts of the *Cerebrum* and *Cerebellum*; so that the upper and lower, and lateral *Sinus* unite themselves in one, called the *Torcular*, in which two cross ways of the upper, lower, and lateral *Sinus* do meet, and hold an intimate correspondence with each other in this common center, and the several streams of Blood run upward and downward into the *Torcular*, and from

from thence are transmitted laterally into the First and Second Sinus, making little trenches cross the *Occiput*, (when it was tender in its first rudiment) and are from thence conveyed to the bottom of the Brain, to a common Receptacle as a kind of Lake; whence it is exonerated into the Jugulars, which are carried in Two Perforations (made fit for them) through the *Os Petrosum*.

As to the Functions of the *Dura Menynx*, they consist in Sense and various Motions, which may be styled Natural or Violent; the First, some fancy to be a kind of Systole or Diastole, Analogous to that of the Heart, proceeding from its carnosus Fibres, irritated by the quantity of Blood, which afterward is impelled through the *Aorta* into the carotide Arteries (seated in the *Dura Menynx*) which being acted with frequent vibrations, do affect this Membrane by consequence, with alternate Motions and Relaxations, following these of the Arteries, which do by their repeated pulsations draw the Membrane into consent, by making impressions in its adjacent parts; whereupon the *Dura Menynx* is not acted with a natural primary Motion, flowing from the peculiar contexture of its Fibres, but only agitated with an accidental Concussion, externally forced by the pulsation of the Arteries.

Some think the motion of the *Dura Mater* is akin to that of the Heart.

And before we quit the Treating of this Coat, it may be worth our disquisition, with what Sense and farther Motion it is endued; and to its more acute Sensation, the most fierce pains of the Head are consigned, but after what manner they are produced, is not so easily understood. It is vulgarly received, that sharp Fumes, mounting up from the Bowels of the lowest Apartment, chiefly from the *Hypoconders*, Womb, and Stomach do strike this Membrane, torturing it with grievous pains, this may quickly be said, but is not so easily made out, by reason it is difficult to apprehend how these vapours should arise out of the lower parts of the Stomach and Gullet, and pass through the Palate, and penetrate the thick Wall of the *Os Cuneiforme*, before they can land at the *Dura Menynx*, and affect it with importunate Sensation: But (I conceive) it may be more probably asserted, that the *Dura Mater* may have sharp contests, arising from the troublesome Steams of the Blood, fermenting within the Brain (confining on the *Dura Mater*) These vapours may be gathered as it were into a cloud, blowing it up with great distention, offering great violence to the curious frame of nervous Fibres, full of most acute Sense: And it hath been often discovered, the Skull having been taken off not long after death, that the *Dura Menynx* hath been blown up like a Bladder, and rendred transparent, as it seemed to be swelled with much Water, contained within it, which was afterward discovered to proceed from Wind, making an inflation in the Membrane, which being Launced, the Swelling immediately vanished, without the effusion of any Liquor.

The pains of the Head.

A cause of the pain of the Head, proceeding from sharp Fumes of the Stomach.

The pain of the Head

And this Membrane is not only obnoxious to great pains, but also suffereth Convulsive motions, caused by a quantity of inflamed Blood, running in the substance of it, producing sometimes vertiginous indispositions, and the Falling Sickness, caused by a malignant quality of the Blood, and Animal Liquor, highly disaffecting the *Dura Mater* till its nervous Fibres are severely tortured, with Concussions, Contractions, which also draw the Nerves into consent, seated in the Muscular parts, so that the Limbs are distorted with violent Motions, which proceed originally from the Convulsive Vibrations of the nervous Fibres, relating to the *Dura Menynx*; but I refer the Treating of this unkindly Sensation, and Motion of the *Dura Menynx*, to the *Cephalalgia*, where I intend to discourse more largely of them.

Convulsive motions of the *Dura Menynx*.

C H A P. XXXII.

Of the Pia Mater.

The situation
of the Pia
Mater.

The Blood-
vessels of this
Coat.
† T. 46. F. 1. gg.

† T. 46. F. 1.
III.
The serous
vessels of the
Pia Mater.

THE *Pia Mater* is seated immediately under the *Crassa Meninx*, facing it with its Convex-Surface, and the Brain with its Concave, representing it in its orbicular Figure, and being every where contiguous to it, encireth it with its tender embraces, and it being a most thin Membrane (is adorned with various divarications of Blood-vessels) † insinuating it self into the deep Interstices of the Brain (to conserve its soft fluid substance, as with Swaths) is extended to the Ventricles, and is beautified with numerous plexes of Vessels descending from the *Crassa Meninx*, lest the small capillary Veins and Arteries should be broken in their long progress into the inward recesses of the Brain, they do lodge themselves within the several Fissures of it, clothed with this delicate Membrane, as in so many safe Repositories; This curious covering is garnished with several bubbles, † filled with serous Liquor, impregnated with Air (in Man, a Calfe, Lamb, and the like, and are lodged in the Vessels running in the Furrows of the Meanders) and the Airy, spirituous parts of the Blood, exalting it self toward the surface of the *Pia Mater*. And this fine coat doth not only line the deep Interstices of the Brain, but so fitly uniteth the tops of its wreathed Partitions, that it rendreth its otherwise plain Figure, orbicular. And this thin Membrane is so closely affixed to the Brain by minute Fibres, that it cannot be parted from it, to discover the rare divarications of Vessels, enameling the surface of the Brain, unless a relaxation be made of the Fibrils, in a Hydrocephalus. *Ut tenues Membranae per nescio quos Intestinales cerebri anfractus insinuatio, & tum exiles venarum, & arteriarum ramuli per intima cerebri penetralia serpentes clarius innotescant. Calvariam pueri Hydrocephalo nuper laborantis, serra Coronae instar aperui, ad latebras cerebri inspiciendas: & Fibrillis, quarum ope tenui Membrana cerebro arctissime annectitur serosa illuvie relaxatis, inde Membrana haec numerosa vasorum sobole stipata, a cerebri conjugio divortium patitur, & flexuosa ejus interstitia tenuiori velo librata jam nuda conspiciantur, aliter convalescenti cerebro, Membrana haec (tenera) licet, validioribus retinaculis alligata, non sine lacerationis metu avellatur.*

The Uses of
the Pia Ma-
ter.

Thus I have given a rough draught of the Veins and Arteries, (whose tender Branches, (like those of the Ivy about the Barky Tree) twine themselves about the *Pia Mater*, to support their weaker Fabrick; and how the *Pia Meninx* is interwoven by them, mutually supporting each other; and in what manner the various Sanguiducts do overspread the surface of the *Cerebrum* and *Cerebellum* in their Intersections, *Sinus*, and Cavities, with their numerous off-spring, which are rarely propagated into the medullary Substance: I conceive it now my Duty to give you in some manner a short view of the Uses and Offices of the *Pia Mater*, which Great *Galen* most elegantly describeth in his Eighth Book, and Eighth Chapter *De usu Partium*. *Ἡ ὀδὸν ἢ λεπτὴ ἀμα ὁδὸν σπρίζει τὸν ἐγκεφαλον, ἀμα δὲ καὶ σκέπει, καὶ ὡς τούτοις ἐπὶ συνδρομοῖς γίνεται ὅς τις αὐτὴν ἀσθενέων ἀπάντων. Tenuis Meninx cerebrum stabilitur, tegit & tanquam*

connexus

Connexus vasorum omnium ipsi innitentium; and at once covereth and supporteth the great variety of Sanguiducts lodged in it.

And this Great Author assigneth a further use of this choice Membrane,

Ἡ δὲ γύμνος ἢ παντὶ ὄντι αὐτῇ σφουγγώδης τὴν καὶ ἀεὶ ῥεῖσιν πλάττειν γίνεται κατὰ πέντε τὰ αὐτῆς, καὶ ὡς ῥεῖσιν τῶν ὀφθαλμῶν εἰς τὰ πλάγια, *Quum nuda sit Figura ejus rotunda & Sphærica plana efficitur, partibus nimirum ipsius superioribus procedentibus, & ad latera circumfluentibus*; The Brain being of a fluid disposition, when left to its own freedom, and being void of Conduct, loseth its former Model, is depressed above, and swelleth in the middle and outward parts; and quitteth its orbicular Figure, in which it emulated a kind of Infinity; and then the noble Functions of the intellectual and sensitive Faculties are at a stand, being amazed at this strange confusion: Wherefore the supream Architect hath well provided for this delicate structure of the Brain, by enwrapping it within the thick and thinner Vests of the *Dura* and *Pia Mater*; and above all, immured it within the strong Wall of the Skull.

Another use may be given of the *Pia Menynx*, that it investeth all the deep involutions of the Brain, and having, though a fine, yet solid consistence, confineth the volatil Animal Spirits (owing their Birth to the exterior parts of the Brain) within their proper Cells and Stations.

The last, and not the meanest use of this Membrane, is, that it serveth as a Fond, at once to convey and sustain their Veins and Arteries, and nervous Fibres, with their fruitful propagations, to impart vital Liquor and animal Juyce, to give Life, Sense, and Nourishment to it, and to export superfluous Blood, thence reconveyed by the Jugulars to the descendent Trunk of the *Cava*.

And in the Veins and Arteries lodged in the Membranes of the Brain, somewhat is worthy of our remark, as well as admiration, that they do not take their rise and progress in the Brain, as in other regions of the Body, the Veins and Arteries associate themselves in the muscular parts, both in the Trunk and Limbs; but the vessels of the Brain begin their course from the opposite side, and do accost the other Vessels. The carotide Arteries climb from the Base of the Skull, and creeping through the Membranes, send upward a multiplicity of Branches, with which the venous Sanguiducts derived from the *Sinus*, and gliding downward, do meet with the rising Arteries; and upon this account, the Arteries and Veins do wonderfully answer one another in their different Divarications; while the greater Branches of the Arteries encounter the smaller Veins, and the greater Trunks of Veins the smaller Arteries.

Learned Dr. *Willis* hath made a curious observation of the vessels of the Brain, that the carotide Arteries of one side are inosculated with the Arteries of the other; and the vertebral Arteries on each side, both unite and espouse each other, and are inosculated into the hinder carotide Branches, and First receive a confederacy with each other, before they admit a near union with the vertebral, and the frequent inosculations of the carotide Arteries in most Animals, are transacted about the lower region of the Skull, under the *Dura Menynx*; And this *Anastomosis* is celebrated in a diverse manner, in some it is in the various plexes of Arteries in the *Rete mirabili* transmitted from one side to the other, and in others, (as it is very remarkable in a Horse) between the great Trunks of the soporal Arteries, a large Arterial Duct is framed, carrying Blood from one region to the other.

Ut autem variarum inter se inosculationum ratio magis elucescat, eo nomine latex purpureus e sinistro Cordis thalamo per elatiorem aortæ truncum &

The Figure of the *Pia Mater*.

The Second use of the *Pia Mater*.

The Blood-vessels have not their rise and progress, as in other parts of the Body.

The Arteries of one side of the Brain, do inosculate with those of the other.

rizulos carotidum interiores in diversas cerebri oras impellitur, priusquam plagas a natura institutas obtinuerit, ut sanguinis particulae ad earum miscelam magis exquisite comminuerentur ne ingens laticis purpurei Torrens in varios partium rizulos longo itinere peragendo per flexuosas cerebri ambages elanguesceret, & inde calore sanguinis nimium defervescente, Spiritus Animales paupertini & quasi emortui collabascerent, nisi a ramulis ab utroque latere obviam euntibus per varias artiarum Anastomoses reviviscerent.

Alia autem & forsan validior est Anastomose^{on} ratio subnectenda, quam sanguineus latex per minutos cerebri ductus huc & illuc expaciet, & vario incidens tramite, eandem assequitur metam, ita ut uno sanguinis canali, sive per compressionem a partium incumbentium tumore, aut aditu per obstructionem a crassis humorum facibus, percluso, novus statim suboritur, ita ut arteria in una cerebri ora, a nimia sanguinis copia, intercepta, a liberioribus alterius ductibus, resarciatur, & alterius lateris carotides utriusq; pensum absolvant: & eodem ritu vertebralibus arteriis graviore humorum sarcina laborantibus obstetricat natura, & carotidum ductibus in utroq; latere perclusis, vertebrales earum suppleant vires, & e contra quicquid in obstructis vertebralibus deficiat, a patentioribus Carotidum rizulis compensetur.

Ac tam venarum quam artiarum par habenda est ratio, & sanguiniductus congeneres cum vasis affinibus fœdus ineuntes, ita ut vena cum venis inosculationes celebrentur, eo nomine instituta, ut vena jugulares unius lateris a lenta, viscida humorum illuvie occlusa, ab apertioribus venis tanquam lateris alterius vicariis suppleantur, ne foribus, quæ regerendi sanguinis provinciae designantur omni ex parte perclusis, & motu ejus versus præcordia humorum interventu intercepto, cerebrum sanguinis inundatione premeretur, unde delirium, stupor, obmutescencia, tanquam graviore Apoplexie Prodromi exoriantur.

Now having Treated of the *Anastomoses* of the vessels of the same Tribe and Family, Arteries with Arteries, and Veins with Veins, I intend now to discourse the inosculations of the Vessels of several Tribes, how they and their offspring espouse each other; how Arteries make a near union and converse with Veins, and inosculate with each other in the *Dura* and *Pia Meninx*. And of this Opinion are diverse Learned Anatomists, as *Dr. Willis*, *Dr. Highmore*, and others of great note; but upon a diligent and curious search, it will clearly appear to a disinterested person, not prepossessed with prejudices; That although it may be easily granted, the Carotide Arteries are often in conjunction with the Jugular Veins, both in the Membranes and substance of the Brain; yet this union of the Arteries and Veins will not amount to an Inosculati^{on}, but only to an Association, and the reason why diverse Antient and Modern Anatomists have been drawn into this Belief, that the Vessels in their several Divarications, sometimes passing over one another, sometimes accosting each other, are so firmly united and espoused, that the Arteries and Veins will not suffer a Divorce, unless a great violence be offered to them, and then hardly quit each other, without a laceration of their Coats. But to put a period to this controversy, and begging the pardon of those Learned Men; I humbly conceive this strict association of the Arteries with Veins in the *Crassa* and *Pia Mater*, to be no true Inosculati^{on}, because there cannot be found by the use of any Instrument, as Probe, or Brissel, or the like, any perforation interceding the Arteries and Veins, whereby they can hold any intimate correspondence, whereby the Purple streams may be communicated to each other, which is necessary, according to worthy *Dr. Highmore's* Opinion, who asserteth in many places of his

The Arteries
do not in-
osculate with
the Jugular
Veins.

his Anatomy of the Brain; That the circulation of the Blood is performed, both in the Membranes and the Brain it self, by many *Anastomoses* of Arteries with Veins: But this Opinion needeth no farther dispute, when it plainly contradicteth *Autopsy*; for in Sense, as yet it cannot be found, that there are any common passages which intercede the Arteries and Veins, to convey the constant current of Blood from one to the other, without being transmitted from the extremities of the Capillary Arteries, through the Membranes to the Capillary Veins.

But it may be easily proved experimentally, That there are many Inosculationes with Vessels of the same kind, either Arteries with Arteries, or Veins with Veins, each of them hold an intimate commerce with other, by one common Chancel, by which the united Arteries and Branches, have frequent Perforations running one into another, and accordingly transmitteth vital Liquor, so that if by any extraordinary accident, the constant intercourse of Blood should be intercepted in One, Two, or more great Branches of Arteries, it may readily be supplied by the Inosculation of subsequent Arteries, which may be experimentally proved, with no less wonder, then delight, by the repeated injections of White Wax, mixed with Cinnabar, and other Liquors, into any one of the Trunks of the *Carotis Interna*, in either side of the Brain; and forthwith the Branches of the Carotides in both sides, as well as the prime vertebral Arteries, shall participate of the Wax and Liquors.

A Person of Eminence and Worth being dead, and his Body Dissected, his Mesentery was discovered to be highly Ulcerous, and his Skull being taken off, and his Brain inspected, one side seemed as it were to be putrefied, and Cavities of the Vessels almost wholly shut up, and the course of Blood in that side totally intercepted; so that it seemed very strange he did not labour under a Delirium, or Privation of his Intellectual, or sensitive Functions, being not afflicted with any Soporosis Indisposition. But on the contrary, when he was sick, he was very clear in the exercise of his Reason and Sense, to the time of his Dissolution, which was occasioned by corrupt Blood, wholly stopped in one side, and the stream more strongly carried on into the Vertebral and Carotide Arteries of the other side, which were doubly enlarged by the great Rivulets of Blood impetuously flowing into them.

C H A P. XXXIII.

Of the Pathology of the Membranes of the Brain.

AS to the Pathology of the Brain as affected with Inflammations, Abscesses, Ulcers, an Epilepsie, and Pains.

The causes of an Inflammation of the Coats of the Brain.

The inflammation of the Membranes of the Brain is caused by stagnation of Blood, impelled by a violent pulsation of the internal Carotide Arteries, into the substance of the Coats, in so large a proportion, that the minute Extremities of the capillary internal Jugulars, are not capable to receive it, whence arise greater or less tumors of the Membranes by the undue detention of more or less Blood, stagnant in the Interstices of the Vessels. And furthermore, the several *Sinus* of the Brain are then overcharged with so great quantities of Vital Liqueur, when the more minute Channels of the Jugulars below are not sufficient to admit the great plenty of Blood transmitted to them; Of which be pleased to take this instance.

An instance of an Inflammation of the Coats of the Brain.

A strong Purgative not good in an Inflammation of the Head.

A Gentleman of Quality of a Plethorick constitution in the flower of his age, taking too great a freedom in the larger draughts of ill Wine, fell into a dangerous continued Fever, accompanied with a fierce *Erysipelas*, signified in prodigious Tumors full of Blisters and Pimples in the Neck and Face, and the Eye-lids so tumified, that he was wholly blind, and in this extremity he sent for a Chymist, as I conceive, a better Operator then Physician, more skilled in the preparing then due administration of Medicines, who giveth him a Purgative in the height of his Disease, which worked freely with him, and strangely discomposing him, brought him a great Stupor, upon which he was deprived of Sense and Speech a small time after the working of the Purgative, Nature labouring under a double violence of a Medicine and a Disease; whereupon his Friends sent to me to visit the Patient, desperately sick, and finding by their observation, that the swelling of his Face and Neck suddenly fell, with the loss of his Sense and Speech upon the plentiful operation of the Medicine, I had reason to believe, that the Blood before stagnant in the Face and Neck moving from the Circumference to the Center, had a speedy recourse from the ambient parts by the external Jugulars into the descendent Trunk of the *Cava*, and was thence transmitted through the right Ventricle and Lungs, into the left Ventricle of the Heart, and from thence imported by the ascendent Trunk of the *Aorta*, and internal Carotide Arteries, into the Membranes and substance of the Brain, in so great a quantity, that it intercepted, by compressing the Fibres of the Brain, the influx of the Animal Spirits into the Nerves, the instruments of Sense, Motion, and Language, proceeding from the stagnation of Blood, whence also arose a great redness and tumor of the Membranes of the Brain, whereupon I immediately ordered, (the Neck being swelled) a Vein to be opened in the Arm, a large Orifice to be made, for the freer emission of gross Blood, to quicken its motion from the Head towards the Heart, and some hours after, I repeated the Blood-letting, and ordered Cupping-Glasses to be applied with deep scarifyings, but all in vain, as being not able relieve the Patient with Bleeding, and the best Cephalick Medicines both inwardly taken, and outwardly applied, the Patient being a worthy Person (I hope through

God's

God's mercy, he most happily exchanged his lower station, for a better above. And in a decent time after his departure, I ordered an expert Chyrurgeon to take off his Scalpe and Skull, where I found underneath, all things answer our expectation, and out of the third *Sinus*, immediately gushed out a Rivulet of Blood, and all the Capillary Arteries (which are so small naturally, that they can be hardly discerned) were here very large and conspicuous in the *Dura* and *Pia Mater*, which were most prodigiously swelled and inflamed to the admiration of the Beholders, the Blood being settled in the Spaces between the Vessels, in so great a plenty, that the Veins were not able to discharge it.

And the *Sinus* were surcharged with so much Blood, that the Jugulars below, were not in a capacity to employ them: Whence is derived an Inflammation of the Coats of the Brain above, the course of the Blood being intercepted in the Veins below, they being not sufficient to reconvey it out of the substance of the Membranes; whence the Blood stagnating, doth lose its Tone, and its Compage growing loose, the Cristalline part doth separate from the Red Crassament, and turning corrupt, doth degenerate into a Purulent Matter, the immediate subject of an Abscess, which being affected with a kind of Caustick quality, corrodeth sometimes the *Dura*, and other times the *Pia Mater*, which being Perforated, determineth in Ulcers, affecting the *Cortex* and substance of the Brain, accompanied with a *Stupor* and *Sopor*, the fore-runners of a fatal Apoplex.

And farther, It may be conceived, and not altogether without reason, that the Coats of the Brain are the subject of the Epilepsy, as they are the Organs of Sense and Motion, and as they are endued with a great number of Nervous Fibres, with which the most part of the substance of the Membranes of the Brain is composed, and are dispersed all over it; And these Coats do not only invest the Brain, but insinuate themselves into the inward Recesses and Fissures of it and the *Cerebellum*: whereupon the Animal Liquor being infected with Nitro-Sulphureous and other malignant Particles, passing into the numerous Fibres of the Membranes of the Brain, do highly irritate those tender Sensitive Filaments, putting themselves upon various inordinate and convulsive motions, in order to discharge the noisome Epileptick Matter, that so greatly offendeth them; and the Membranes not only investing the *Cortex*, but also the Medullary Processes, being highly contracted do compress the Brain, and hinder the intercourse of the Animal Liquor and Spirits, disturbing the sensitive and nobler Intellectual Operations; and do also, being hurried with violent concussions, draw the appendant Nerves into consent, affecting them and the Muscular parts with most fierce and Convulsive Motions, most terrible to behold.

The *Cephalalgia* or Pain of the Head is seated principally, if not wholly in the *Dura* and *Pia Menynx*, and may be (as I conceive) defined a troublesome sensation of the numerous minute Fibres integrating the Membranes of the Brain, flowing from the solution of the Continuity; And according to the greater or less extent, is called Universal or Particular; Universal when all parts of the Membranes are affected, and Particular, called *Hemicrania*, when one side of the Head, or the *Sinciput* or *Occiput* are molested.

And in the *Cephalalgia*, I shall give you a short History of the parts affected, the Essence, Causes, and Differences. As to the subject of it, it is chiefly found in the Nervous Fibres of the Membranes of the Brain, which being endued with acute sense, do easily suffer pain, proceeding from some disproportioned object wherein the Fibres are over-much extended with Mat-

The description of the Pain of the Head.

ter, is so highly contracted, and as it were convulsed with acid Saline Particles, causing a violation of the continuity of the Nervous Filaments composing the Coats of the Brain; So that wheresoever pain doth arise in the Nervous parts, the *Ratio formalis* of it consisteth in this, That the Animal Spirits being associated with Heterogenous Particles, are so confounded, and aggrieved, that they make either great distentions, or contractions in the Nervous Fibrils, causing an unpleasant sensation: And the reason is, as I conceive, because some disproportioned Object doth highly disorder the Animal Spirits, and so boisterously insinuate it self into the Pores and Interstices of the Fibrils, violently parting them one from another, thereby forceth the Animal Spirits into a disorderly motion, producing a troublesome sensation, in which both the parts affected and the essence of the *Cephalalgia* do consist.

The Causes of the pain of the Head.

As to the different causes of it, I conceive them either to be Blood, or its Albuminous Juice, by which it is supported, or the Recrements, the Bilious and Serous parts of the Blood, or the Animal Liquor: Blood being impelled with a great torrent into the Carotides, lodged in the *Dura* and *Pia Menynx*, is sometimes stopped after a manner by the straightness of the Vessels, which being somewhat tumified, do compress the tender neighbouring Fibres, giving them a troublesome sensation, which is also frequently derived from the effervescence of the Blood, caused by immoderate exercise, drinking of strong drinks, bathing, and the like.

The ill Nervous Liquor is sometimes a cause of the pain of the

The Chyle is carried with the Blood upon great passion or immoderate exercise upon a full stomach, by the Arteries terminating into the substance of the Membranes of the Brain, and it being crude and indigested, is not able to be received into the Coats of the Nervous Fibres, being after unfit for assimilation, is sometimes lodged in the interstices of the Vessels, where the Chyle being acted with undue Fermentation, rendreth the soft Nervous Filaments uneasy.

The watry recrements of the Blood are sometimes a cause of this pain.

At other times the watry recrements of the Blood (impregnated with sulphureous, and sometimes with sharp, saline or acid Particles) are transmitted out of the Extremities of the Capillary Arteries into the Vacuities interceding the Vessels, highly discomposing the Nervous Fibres of the Membranes and producing an acute pain of the Head.

And lastly, The Animal Liquor being not well prepared in the *Cortex* of the Brain, or else affected with other Recrements, is so gross, that it cannot freely pass between the Nervous Fibres appertaining to the Coats of the Brain, in which the Nervous Liquor somewhat stagnating, doth enlarge the Interstices of the Filaments beyond their natural extent, giving a trouble to these sensitive parts, which are irritated to discharge the Plenitude of this Nervous Liquor, lodged between the Filaments of these Fibres.

C H A P. XXXIV.

Of the Origen of the Brain.

HAVING given you a sight of the Cabinet, I will now present you with the Jewel, all cut in Wreaths and Mæanders; having shewn you the Shell, I will now give you the substance: And first the Origen of the Brain, the conception of which appeareth first as in an Egg without a Shell, and the Cristalline Seminal Liquor is enwrapped within a more tender Membrane, which is the *Corion*; And afterward in the space of four days is celebrated the first period of producing the *Fætus*, wherein the Blood, Veins, and Beating-point borrow their rough delineation, without the least shadow of the Head; In the next period appear some glimmerings of it, a Conglobated part, made up of three Vesicles, filled with a Limpid Liquor, and are the immediate *Materia substrata* of the Brain, *Cerebellum* and Eye. They have their first formation out of that Genital transparent Matter, which though it seem to be Homogeneous, yet is composed of different parts, more plainly discernible, when they arrive to greater maturity, and then the *Cerebrum* and *Cerebellum* may be distinguished, and the fibrous and pulpy Particles, into Vessels and *Parenchyma*, which do integrate the *Cerebrum* and *Cerebellum*.

The fibrous (as I conceive) do borrow their first production, after this manner.

The Seminal Liquor being enobled with active principles, and inspired with spirituous particles of Volatile Salt and Sulphur, do grow farther exalted by Fermentation, wherein the more thick and solid separating from the thinner and serous parts, are made more tenacious and firm by the ambient heat of the *Uterus*, by which they are rendred somewhat more indurate then the Pulpy, growing by degrees Fibrous, whereupon they are made capable of gentle tension, and relaxation, as they are more or less invigorated with Animal Spirits, no way communicable to the unactive, flabby and pulpy substance of the Brain, formed out of the more serous parts of the Seminal Liquor, which is by degrees Coagulated into a white Pulp, a more friable substance then that of the Nervous Fibres, and is turned from a thin Whey Liquor into a kind of *Coagulum*, caused by the gentle heat of the *Uterus*, and the mixture of some Saline Particles, which being added to the oily, concrete it into a white Pulp, adhering to, and filling up the Interstices of the Vessels and Fibres, which are thereby covered, and the *Cerebrum* and *Cerebellum* rendred equal.

The first period productive of a *Fætus*.
The second period.

The manner how the Fibres of the Brain are produced.

C H A P. XXXV.

Of the Fabrick and substance of the Brain.

THe Brain, the most noble part of the whole Body, in reference to its Divine operations, hath a Fabrick fitted to accomplish them, being finely compos'd of great variety of minute Fibres, seated one above another in excellent order.

And that we may make a better inspection into these curious minute Bodies, it may not be (as I conceive) unworthy our notice to treat of these particulars; The Origen, Nature, Figure, Progress, Uses, and Actions of these Fibres.

The Origen
of the Fibres,

The Compage
of the Brain
is made of
minute Fi-
brils.

As to the first, they may be considered in relation to their generation or dispensation; as to the later, they borrow their Roots from the *Cortex*, and if taken in order of Generation, they derive their birth from the more viscid part of the Seminal Matter, which being first colligated by the heat of the *Uterus*, into a thin Crystalline Liquor, is afterward somewhat indurated, and as it were coagulated by a quantity of Volatil Salt into a white clammy substance, divided for the most part into most numerous Fibres, which leadeth me to the nature and substance of them, as they are most solid and tough Particles of the Brain, whose greatest part is a curious Compage made up of innumerable nervous Filaments, and Vessels, whose empty Spaces are interlined with a soft kind of *Parenchyma*, which is nothing else (as I conceive) but the Animal Liquor affixed to the outside of the Vessels.

These minute Fibres are most evident in the Brain of some Fish, which is compos'd in a Holybut, of an innumerable company of small long Processes, and are, as I conceive, upon a strict survey, nothing else but so many minute Filaments, so curiously joyned together with little thin Membranes, that they seem to be one entire Body, running all along from the anterior to the posterior region of the Brain, consisting of many subordinate ranks, seated in great order one under another; So that I conceive these numerous Filaments to be a system of Vessels containing and transmitting Animal Liquor through all the Coasts of the Brain, which I more plainly perceived in the Brains of Fish, which being wounded, and the Filaments cut, immediately out of them quickly distilled a quantity of serous Matter, which is without question nervous Juice, flowing out of the wounded Filaments of the Brain, which being held over the Fire, did coagulate into a white substance, not unlike the White of an Egg.

The Substance
of the Brain
is made up of
many Glob-
ules in Ani-
mals.

So that the Compage of the Brain of different Animals, Men, Beasts, Fowls, and Fish, are framed of a number of Globules, as so many small Bodies of various shapes and sizes.

These Globules (as I apprehend) are aggregate Bodies, consisting chiefly of Fibres, and some Arteries and Veins, and perhaps Lymphæducts, which may be worthy a curious search, because it is not altogether unreasonable to imagine, where so many various, nervous Fibres are lodged, that they may be accompanied with Lymphæducts as well in the Brain, as in other parts of the Body.

As to their Fabrick, these Globules being a great company of greater and less Tubes, and Fibres, formed (as I conceive) in larger or smaller Arches, one seated above another, the greater being placed near the ambient parts, grow less and less, as they approach the inward Recesses, till at last they come to a kind of plain, into the middle of these Collective Bodies, which in their Figure and Colour very much resemble Glands, and so may truly deserve this appellation, in relation as they are consigned to the same use with Glands to percolate the Liquors of the Brain, and render them fit for the Generation of Animal Juice, which may be produced, (as I fancy) after this manner.

The Globules of the Brain are a company of Vessels.

The Albuminous part (being in confederacy with the Juice) when it is transmitted into the body of these Globular Glands, the purer part being secernd and impregnated with Volatil Salt, is received into the Origin of the nervous Filaments, and so by degrees conveyed through all the Processes of the Brain.

As to the Figure of these small Fibres, the white streaky Particles of the Humane Brain are divided into a multitude of little depressed round Processes, somewhat resembling those very minute Intestines, those small Bodies, that make the bulk of the Testicles, and are so remarkable in the Ventricles and in the Brain of Fish, that if they be exposed to the opposite light, they may be discovered to be ranked in such order, that they running in parallel Lines, represent the Teeth of an Ivory Comb, and in the *Cerebellum*, many *Laminae* are seated upon each other, from which many nervous Filaments sprouting out and equally spreading toward the Surface, do represent the Branches of Trees, variously sporting their smaller Twigs clothed with tender foliage.

The Figure of the Fibres of the Brain.

These minute Fibres being the *Prima Nervorum Stamina*, the very Lineaments in which the Nerves are first designed.

And do borrow their birth from the ambient part of the Brain, implanting their tender winding Fibrils into the Cortex, which are thence propagated through the *Corpus Callosum*, transversely overspreading, as with a Seeling the arched Chambers of the Brain, and afterward the *Medulla oblongata* is all beset with nervous Filaments, very conspicuous in the *Corpora striata*, the first beginnings of the *Medulla oblongata*, and may be called *Duo Vasorum Fasciculi*, two rare systems of Filaments, passing through the Caudex of the *Medulla oblongata*, and at last uniting themselves toward the lower Region of the *Medulla*, do constitute the bodies of Nerves, made up of these numerous Filaments; And now I will not insist any longer upon the rise and progress of these Fibres, because I shall have occasion to discourse more fully of them hereafter.

As to the uses of these numerous Filaments, the first may be to fortifie the Brain, whose *Parenchyma* being of a tender fluid nature, would easily be removed out of its proper place, were it not supported by these more solid Fibrils, which are the more firm Particles of the Brain, and are as so many *Fulcra* to under-prop it, lest in violent concussions, this soft Fabrick being very ponderous, should subside and compress the Capillary Vessels, intercepting the due motion of the Blood.

The first use of the Filaments of the Brain.

Another use of the Nervous Filaments, may be as Repositories, or rather minute Channells of the Animal Liquor wherein it is conveyed through the various Processes of the Brain, into the body of the Nerves, which is much quickned by the accidental motion of the Brain, caused by the pulsations of Arteries, but principally by the gentle, natural, opposite motions, produced by contraction and relaxation of the Fibrils, flowing from the dictates of the

The second use of the Filaments of the Brain.

Appetite and sensitive operations, more intensely or remissly framed according to the more passionate or cooler inward acts, or according to the brisker or fainter impressions, made upon the Fibres of the sensitive Organs by stronger or weaker appulses of outward Objects; But I refer the more large discourse of the uses and actions of the Fibres, and that of the Nervous Liquor transmitted between their various Filaments, to a farther discourse.

The whole Compag of the Brain emulating a Globe, is divided a great way into two equal parts, having a Fissure parting the Brain in the middle from the Surface to the *Corpus Callosum*, in which is lodged a Duplicature of the *Dura Meninx*, dividing the Orb of the Brain into two Hemispheres†, so styled by Learned Dr. *Willis*, which rather (as I humbly conceive) form two parts of one Hemisphere, because if both sides were closely united, they would make but half the Globe, unless the partition were made from the surface to the base of the Brain, which is only made in the hinder part lying on the *Cerebellum*: And therefore the two upper sides distinguished by the Falciforme Process being separated from the *Corpus Callosum*, may be more properly called two portions of one, then two distinct Hemispheres.

The Hemispheres of the Brain.
† T. 46. F. 1.
& 444.

The situation of the Hemispheres.

As to their situation, their upper Region confineth upon the *Pia Mater*, and their lower on the *Corpus Callosum*; Their middle on the Falciform Process; Their Surface is beautified with a pleasant prospect of various Circumvolutions full of numerous Branches, and Capillary Arteries and Veins, ascending and descending into them, and above all, adorned with a multiplicity of minute nervous Fibrils, the first rudiments of Nerves.

These *Anfractus* consist of a Cortical, Cineritious, and a more bright Medullary substance, which are so finely interwoven with divers insertions made one into another, that they will admit no separation, but the more inward Recesses of these Hemispheres are more entire, being framed of a white Medullary substance derived to the *Corpus Callosum*.

CHAP.

C H A P. XXXVI.

Of the Cortex of the Brain.

HAVING unveiled the Brain of its upper and lower Vests, and discoursed somewhat of the Hemisphæres, and of the Origen, and Compag of the Brain in a general Notion; I conceive it not altogether improper, to give you a more particular account of the Brain, which may be divided into a Cortical and Medullary substance: The First is Ash-coloured, the other White. The Brain is made up of many parts and Processes, wonderfully framed, as so many *Tubera* hanging together, as with short stalks, rarely conjoyned; and though they be distinguished from each other, yet every Process claims to its self its proper form, into which it is expanded, and seemeth to contain a little volume, and there being many Leaves all bound up together, make one entire round Model, in which it is very difficult to discover the beginning and end, and the several confines of every distinct part of the Brain; the several Processes being so curiously framed, and enwrapped one within another, that it will require a skilful hand to unfold them, without offering a violation to their proper Coats, which are so nearly contiguous to each other.

The ambient part of the Brain, commonly called the *Cortex*, every way overspreadeth the *Medulla*, and is adorned with small Sprouts of Arteries and Veins, rarely enwrapping the Surface of the Brain, and resembling so many Tendrels of Vines, encircling an Arched Frame.

The *Cortex* of the Brain is rendred unequal, with many partitions running, in Labarinths and Mæanders, not unlike the circumvolutions of the Intestines † and passing from the fore-part of the Brain to the hinder, in a winding circumference, do encompass both Hemisphæres, and give a mutual reception to each other. And in a moist Brain, long kept from Interment, and tending to Putrefaction, the *Pia Mater* may be easily separated from the Brain, and the tops of the Circumvolutions may be parted, so that you may pry into the bottom of the Interstices, and plainly see, as it were, the Furrows made in the substance of the Brain, not carried forthright in any direct progress, but as it were mutual circumvolutions, intersecting each other; so that the bottom of every furrow, taking its rise from the Right side, passeth toward the Left; then the subsequent beginneth from the Left side, and turneth up to the Right, making a decussation with the former, and so consequently, all the Circumvolutions placed in the bottom of the several Furrows, conclude in the substance of the Brain, and observe the same Method and Order.

If any person should be so inquisitive as to demand a reason of these *Anfractus* of the Brain, it may be replied, (as I conceive) That the outward Surface and *Cortex* of the Brain is finely wrought with several small capillary Arteries, and nervous Fibrils, rarely interwoven with the substance of the *Pia Mater*, and securely lodged within the winding Interstices of the *Cortex*, and Medullary substance of the Brain, to give the first conception and Birth to the nutritious Liquor; and afterward to distribute it to the inward Reces-
ses. And because this subtle Alimentary Juyce cannot freely expatiate in
large

The parts of
the Brain.

The Arteries
and Veins of
the Cortex.

The Cortex is
full of Gyres.
† T. 46. F. 1.
e e e e.

The *Pia Mater*
may be
severed from
the Brain,
when it tends
eth to putre-
faction.

The rise of
the Circum-
volutions of
the Brain.

The cause of
the Flexures
of the Brain.

large Channels, without the danger of losing its volatil delicate Particles; whereupon Nature hath confined it within some small Pores, for its greater security; and because it is requisite the Brain should be supplied with a due proportion of nutritious Liquor, not only dispensed in an equal surface, but that the Risings and Fallings of it would be garnished with various deep Intersections, that their secret spaces may be more enlarged, to give a free reception to the Alimentary Liquor.

The Second reason of the winding Furrows of the Brain.

Another reason may be given of the Intestine Flexures of the Brain, to receive more minute Vessels into their soft embraces to secure them from outward accidents, and the brisker motions of the Head. And above all (as I humbly conceive) these Circumvolutions were made by a Divine Hand, to convey the Capillary Vessels of Arteries and Veins in Mæanders, to give the vital Liquor a softer current through the winding Valleys, that when the streams of Blood are imported to the substance of the Brain, a secretion may be made of the *Succus nutritivus* from the florid part of the Blood, which could no way be well performed, if the Blood were hurried through the substance of the Brain, with an over-hasty torrent.

The Cortex is intermingled with the Medullary parts of the Brain.

The Cineritious part of the Brain doth not only superficially invest, as the Bark doth enwrap the wood of the Tree, but part of the Cortex (as it may be easily discovered in the dissection of diverse more perfect Animals) is seated also about the *Corpus Callosum*; and also part of it is propagated to the Ventricles, and principally near the Origen of the *Spinalis Medulla*, where the Medullary substance of the Brain is encircled with thin Ash-coloured veils, and some prominences of the Ventricles are partly made up of the Cineritious substance, which doth not only continue in the Brain, but is also propagated in a long Tract through the *Medulla Spinalis*, not covering its outward Surface, as in the Brain, but retireth it self through the more inward Recesses of the *Medulla Spinalis*, which are encompassed with it.

The Cerebellum is endued with cineritious Laminae.

But in the *Cerebellum* as well as the Brain, this Cineritious body plainly appeareth, and its productions like thin *Laminae* overspreading the *Cerebellum*, are propagated over its substance, resembling a semicircular Figure.

The colour of the Cortex cometh from a small number of Blood-vessels.

But what may speak the nature of this Cineritious substance is very hard to determine; I conceive it not altogether improbable to be a Compage made in some sort of Red concremented Blood, adhering to the Interstices of the Vessels; as the Liver is formed in relation to its Red substance, as some will have it; But I apprehend the substance of the Cortex to be naturally White, and of the same colour with the other Processes of the Brain, and receiveth its alteration in colour, from an innumerable company of small sanguineous Vessels, which disperse the more delicate part of the Blood, into the substance of the Brain, making no long stay in the Cortex, giveth it a Blush of Purple, retaining somewhat of the tincture of Blood, and somewhat of its White primitive colour of the Brain, giving it a mixed colour, making the White in some sort Livescent, which is a kind of Ash-colour.

The Cortex is a Compage of minute Glands.

Ingenious *Malpighius* pleaseth himself in a kind of description of the Cortex, as it is an aggregate Body, composed of a great number of minute Glands, so finely adapted, and curiously conjoyned, that they seem to make up one continued body; They have (saith this great Author) an Oval Figure, and somewhat compressed by lying one upon another; whence proceed divers obtuse Angles, and yet are laid in such an excellent order, that they give a kind of evenness to many intermedial spaces. And he farther explaineth the nature of the Cortex with a familiar instance, resembling the structure of a Pomegranate, whose well composed frame, derived from the

The structure of the Cortex resembleth the frame of a Pomegranate.

variety

variety of grains fitly united, seemeth to represent the *Cortex* of the Brain, and the minute Fibres sprouting from every grain, and propagated through their Membranes, seem to give a rough draught of the *Cortex*.

And the Author farther confirmeth his Opinion, with an illustration taken from the observation of Mr. *John Psil*, who in the dissection of a Brain, discovered a stone, and globular Figure, like a Mulberry, compounded of many very little Ash-coloured Stones; it being probable, (saith he) that the Stone was formed of a putrified part of the *Cortex* of the Brain, retaining the natural Figure of the Glands.

The *Cortex* of the Brain is curiously framed of a Cortical and Medullary substance, whose thin Processes are so insinuated into each other, and so intimately confederated, that it is impossible by the power of Art to sever them.

The outward surface of it is elegantly enameled with great and numerous branches of Arteries and Veins, and is cut into deep trenches. The repositories of these Vessels, and of divers transparent Vesicles, lodged both about the Surface, and in the Furrows of it.

In a Humane Brain divested of the Skull, between and upon the *Anfractus* and *Mæanders*, running pleasantly both in the anterior and posterior Region of the Brain; I plainly discerned Vessels very much distended with a transparent Liquor embodied with Air; the most eminent cause of its Transparency, proceedeth from the beams of Light, which being thin and spirituous, are easily transmitted through the Pores of a loose fluid Body.

These vessels being swelled with a thin serous Liquor, were very protuberant, as so many Vesicles of different sizes and shapes, some globular, some oval, or triangular, others quadrangular, *Parallelograms*, or Pyramidal.

In some Vessels, the transparent Vesicles, fraught with serous Aereal Juyce, run all along a good way like Beads, being numerous, small, orbicular Bodies. These bubbles are most conspicuous also in the Brain of a Calf, Sheep, and other perfect Animals, and are lodged in the *Pia Mater* and Surface of the *Cortex* about their Vessels.

The *Dura Mater*, and not the *Pia* and *Cortex* of the Brain of a Doe, is furnished toward the Ambient parts with variety of Bubbles, or serous Vesicles † inspired with Air, which are most conspicuous in their great Transparency, and are endued with several shapes and sizes.

I discerned also through the Coats of the Cortical Vessels, some Particles (as I conceive) of the serous Liquor, appearing in small round White Bodies, coagulated in the mass of Blood, which were confined within Red Lines, parting those White concreted Globules, being (as I apprehend) the First rudiment of the Animal Liquor. So that in diverse Vessels are lodged, many White consolidated Bodies of different Forms and Magnitudes, which I conjecture to be part of the Chyme, not assimilated into Blood, whose Compage being loosened in time of Life, the purer Particles of the more fluid serous Liquor, are in a disposition to be secerned from the Red Crassament, when they are transmitted into the Cortical Glands.

Whereupon I am induced upon probable ground to believe, that the nervous Liquor receiveth its *Materia substrata* from the more delicate Particles of the Chyme, and serous Liquor, severed from the Purple Liquor in the body of the Cortical Glands, where it encountreth the more pure parts of Air, transmitted into these excellent Colatorie, the great instruments in the production of the nervous Liquor.

Serous Vessels seated among the *Anfractus* of the Brain.

The Figure of the serous Vesicles.

The serous Vesicles in the Brain of a Doe.
† 52. F. 1.
ccc.

The (of the nervous Liquor.

The nervous Liquor is made of the more mild part of the Blood.

The Air insinuates into the inward parts of the Brain, and mixeth with the *Succus Nervosus*.

The Air impregnated with the more noble influence of æthereal Particles, streaming with the beams of Light out of the Sun, and other lesser Planets, is first received into the Caverns of the Nostrils, and thence transmitted through the mammillary Processes into the Ventricles of the Brain; and afterward it being a most fluid thin Body insinuateth it self through many minute Pores of the inward Recesses of the Brain into the substance and ambient parts of the *Cortex*, where it meeteth and embodieth it self with the serous parts of the Blood, which are highly refined with the spirituous parts of the Air, and volatil saline Particles of the Brain: All which mixing together, receive great improvement by Intestine motion, in which the more gross parts of the Albuminous Liquor are separated from the more pure in the body of the *Cortex*, and are received with the Blood into the Jugulars; whereas the depurated Particles being the nervous Liquor, are transmitted into the Origens and Roots of the nervous Fibrils, and thence propagated through the several Processes of the Brain into the Trunks of the Nerves, made up of numerous Filaments, curiously conjoynd to each other, by the mediation of thin Membranes.

The seat of the Cortical Glands.

These Cortical Glands, being lodged in variety of Flexures, do make the outward Gyres of the Brain, and are appended to the Medullary Fibrils; so that wheresoever you cut the Interstices of the *Cortex* overthwart, the Compage of the Glands seems to overspread the *Medulla* of the Brain.

The Blood-vessels of the Cortical Glands.

And sanguineous Vessels do strew the outward parts of the Cortical Glands, of which the winding intersections of the Brain are formed; so that you may see the *Pia Menynx*, curiously made up of a reticular Form or Network, wrought with great divarications of Arteries and Veins, which deeply penetrate the inmost substance of the Cortical Glands; and being dissected, the Red points of Blood distilling from the small Vessels, discover themselves: And those Glands are also furnished with many White Fibrils, conigned to convey the White Animal Liquor, which may be set forth by a similitude drawn from Plants, implying that the Herbs and Trees derive their Aliment from the Rind, formed of diverse united Fibrils; and the *Cortex* of the Vine or Tree, holdeth an Analogy with this structure, and there is a like implication of nervous Fibrils, both in the *Cortex* and Brain it self, to transmit the Alimentary Liquor to the *Medulla Oblongata* & *Medulla Spinalis*, and thence to the Nerves.

The Glands are appendant to numerous Blood-vessels, endued with various Plexes.

Learned Dr. *Willis* relateth, this ingenious Opinion of *Malpighius*, asserting the sanguineous Vessels (overspreading themselves over the *Pia Mater*, and the Veins climbing up from the opposite Coats of the Brain) do acost each other, and espousing themselves with mutual Inosculation, do not immediately discharge the vital Liquor, as in other parts of the Body, but being variously complicated, make diverse admirable Plexes, to which are appended many small Glands, which may be seen in those Plexes (which are styled *Chorooidal*) seated both in the Ventricles of the Brain, and behind the *Cerebellum*: But Dr. *Willis* farther affirmeth in his Anatomy of the Brain in these words, *Verum ejusmodi vasorum plexus, cum Glandulis intersectis, per totum cerebri & cerebelli ambitum & interius recessus, ac præcipue inter anfractuum & interstitionum hiatus ubique sparsi conspiciuntur.* And this may be more plainly discovered in a moist Hydropick Brain, where the minute Glands, (otherwise obscuring themselves) being puffed up with serous Liquor, are easily made obvious to our sight. Moreover, these Plexes being every way beset with small Vessels, are propagated from them, into the Cortical and Medullary

Medullary Substance of the Brain and its appendage; whence we may plainly perceive, that these two great Authors do agree, that the *Cortex* is furnished with an innumerable company of Glands, but differ in the assignment of their use. Dr. *Willis* assigneth them this Office, that when the Albuminous Liquor is separated from the Blood in the *Cortex*, and passeth through the substance of the Brain, the superfluous moisture is conveyed to the Glands, and so transmitted into the Veins; But *Malpighius* is of this opinion, That the Animal Liquor elaborated in the Glands, is conveyed through many nervous Fibres (every Gland claiming its proper Fiber) and thence dispensed through the several Processes of the Brain, to the greater nervous Ducts, seated in the *Medulla oblongata*, and *Spinalis*.

The use of the
Cortical
Glands.

CHAP. XXXVII.

Of the Animal Liquor.

HAVING Treated of the *Cortex*, as a Systeme of numerous Glands, the refiners of the Blood; I will now take the freedom to speak of the Animal Liquor, and the product of it, and the great end and perfection, to which all the Coats, various Processes, and Nerves of the Brain are consigned; and will give you, *ὡς ἐν πτω*, a brief History of its production, progress, and what improvement it maketh by several local and Intestine motions in the Chyle, and serous Liquor of the Blood, in the Stomach, Intestines, Mesentery; and how the nervous Juyce enobleth the Blood in the Spleen, Liver, Kidneys, and the chambers of the Heart, and in its passage through the Lungs, and ascendent Trunk of the *Aorta*, leading to the carotide Arteries, which import Blood, (impregnated with nervous Liquor, and diluted with *Lympha*) into the Membranes and substance of the Brain.

The Animal Liquor, (the seat of most refined Spirits, the ministers of Intellectual and Sensitive Operations) oweth its Origen to the ambient parts of the Brain, and is thence propagated by innumerable Fibrils, through various Processes, to the lower parts of it, and is thence transmitted through numerous Nerves, as so many Out-lets, and Channells leading to the middle and lower apartments of the Body.

So that this Liquor (distilling out of the Third, Fourth, and Seventh pair of Nerves) maketh the nobler parts of the Juyce, squeezed out of the Tonsillary, and Maxillary Glands, as well as those of the Palate, and Tongue: Whereupon the Salival Juyce being highly improved by nervous Liquor, is mingled with Alimentary Juyce, extracted out of Meat, chewed in the Mouth, where it is embodied with the fluid and elastick Particles of Air, opening the body of the Aliment, and rendring it fit for motion; and as a Ferment giveth the first rudiment to the concoction of Meat, in order to the preparation of the milky extract, afterward elaborated in the Stomach, assisted with an access of new Liquor, flowing from many Nerves, derived from the intercostal Branches, and the *Par vagum*, and divers mesenterick Plexes, emitting fruitful juyce, into diverse neighbouring parts, and do at last terminate into the glandulous Coat of the Stomach, out of which the Nervous Juyce is crushed by the gentle contractions of the carnous Fibres, into the Crust investing the inward Coat, all beset with minute Glands, in which

the

the nervous Liquor is percolated; thence distilling into the Cavity of the Stomach, and insinuates it self (as impregnated with volatil saline Particles) into the substance of the Aliment, and openeth its Compage, severing by a kind of precipitation or colliquation at least, the Alimentary Liquor from its more gross *Fæces*; so that the nervous Liquor, enobled with Spirituous parts, doth embody with the serous parts of the Blood (distilling out of the extremities of the Arteries, into the substance of the Glands, and thence into the Cavity of the Stomach) and make a fit *Menstruum* to dissolve the Compage, and colliquate the Meat, out of which the Chyle is extracted somewhat after the manner of a Tincture (*Ad Balnei Calorem*, by the ambient heat of the Stomach) which is afterward more exalted by its farther progress through the Intestines by Liquor, distilling out of the Nerves, implanted into the Glands of the Guts, and thence transmitted by many minute Ducts into their Cavities; wherein the Chyle being meliorated and attenuated by the access of this nervous Juyce, is carried by the first *Lactææ*, into the Glands of the Mesentery, where it encountreth a Juyce dropping out of the terminations of the Nerves, and is farther matured, and afterward imported by a Second kind of lacteal Vessels, (taking their rise in the Mesenterick Glands) into the common receptacle, in which the *Lympha*, impregnated with some part of the nervous Liquor (as being a Recrement of it) doth both dilute and attenuate the Chyme, and render it more fit to be transmitted through the thoracick Ducts, into the subclavian Veins, wherein it meeteth with more *Lympha* (acted with some part of nervous Juyce) conveyed by the Lymphæducts of the upper Region, and its adjacent parts, into the Vessels seated under the Clavicles, in which the Chyme doth first of all associate with the Blood, and is adopted into the vital Family, and is afterward carried down by the descendent Trunk of the *Cava*, into the Right Cistern of the Heart, wherein it groweth more refined by a mixture of Liquor, squeezed by frequent Contractions of the Heart, out of the terminations of the numerous Fibres, derived from the recurrent intercostal Nerves, and the branches of the *Par vagum*, inserted into the inward Walls of the Right Chamber of the Heart; out of which the Blood being impelled through the pulmonary Artery into the substance of the Lungs, (where, as I humbly conceive) it receiveth the Tincture of a Liquor, distilling out of the nervous Fibres implanted into the Bronchia, Vesicles, and Coats of the Arteries of the Lungs; and afterward the Blood being meliorated with nervous Liquor, is received into the extremities of the pulmonary Veins, and transmitted into the Left Ventricle of the Heart, wherein it is farther heightened by a Juyce, coming out of the Fibres, ending into the inward Coat of the Left *Sinus*; from whence it is thrown first into the common, and then into the ascendent Trunk of the *Aorta*, whose outward Coat is encircled with many divarications of Nerves, inserted into the inward Recesses of this great Artery; so that the Blood passing through it, and the carotide Arteries, is embodied with a choice Liquor (dropping out of the terminations of nervous Fibrils) and afterward imported into the *Cortex* of the Brain, as a Systeme of many small Glands, in which is made a percolation of the vital Liquor, by severing the more mild part from the Red Crassament. This gentle Liquor is exalted by the volatil Salt of the Brain, and is mixed with nitrous elastick Particles of Air, First imparted to the Blood in the Lungs, and afterward conveyed with it through the Heart, and the ascendent

ascendent Trunk, and carotide Arteries into the *Cortex*; into which also the Air, received by the Nostrils, is carried through the *Os spongiosum* into the Ventricles of the Brain, and through the porous parts of various Processes, into the ambient parts of the Brain, where the Air embodieth with the serous parts of the Blood (secerned from the Purple Liquor in the substance of the Cortical Glands) and highly improveth it with its active, nitrous elastick Particles, very much enobled with æthereal minute Bodies, derived from the Cælestial Influxes of the Sun, and other Planets; so that this exalted spirituous Liquor is first generated in the *Cortex* of the Brain; from whence it is transmitted into the Origens of numerous Fibrils (taking their rise in the Cortical Glands) and afterward propagated by many minute Fibres, through the various Processes of the Brain, to the Trunks of the Nerves (First appearing about the *Medulla oblongata*) and then the Animal Liquor is carried between the Filaments of greater and less branches of Nerves, into all parts of the Body, to give them Sense, Motion, and Nourishment; of which I intend now to give a brief account.

The *Parenchyma* of the *Viscera* and Muscular Parts, chiefly made up of greater and smaller Vessels, consisting of Trunks, and many Branches, Ramulets, and Capillaries of Blood-vessels, and Plexes, and Fibres of Nerves, Lymphæducts, and also Membranes, which are fine Contextures, composed for the most part of numerous Fibrils, curiously interwoven, interspersed with many Branches of various Sanguiducts.

The Blood is impelled out of the terminations of the Arteries, into the spaces (running between the Vessels) wherein its more mild and crystalline part embodies with a fine Liquor, distilling out of the extremities of the Nerves; so that the greatest part of the Blood, being mixed with the nervous Juyce in the Interstices of the Vessels, insinuates it self through the minute Pores of the Coats (relating to the Vessels) and Fibres of Membranes: so that the Atomes of the *Succus nutritivus* agreeing in shape and size with the Pores of the Coats of the Vessels, and other Membranes, is carried into their most inward Recesses, where it groweth more solid, and by a kind of accretion, uniteth it self to the body of the Vessels and Membranes, and becometh one entire substance with them, which is called Assimilation, chiefly acted by nervous Liquor, inspiring the serous parts of the Blood with Animal Spirits, giving a power to the *Succus nutritivus*, fitly to accresce and configure it self to the unequal inward surfaces of the lank solid parts, by replenishing their spaces, rendred empty by the heat of the Blood, opening the Pores of the Body, and breathing out constant *Effluvia*.

The manner
how Nu-
trition is per-
formed.

C H A P. XXXVIII.

Of the Animal Spirits.

HAVING Treated of the Animal Liquor, I deem it methodical to give you an account of the Animal Spirits, the more refined Particles of the nervous Juyce, generated in the Cortex: And indeed nothing I think conduceth more to the knowledge of the admirable Fabrick and use of the Cortex, and all other Processes of the Brain, then in some sort to be master of the subtle notion of the Animal Spirits.

These great Ministers of State, by which the Souls Glorious Empress of this Microcosme, giveth her Commands to the rational Function, as the more noble, and to the Sensitive, as her meaner Subjects.

The parts of
this Discourse
relating to
the Animal
Spirits.

That we may more methodically proceed in the curious scrutiny of the intricate Nature of the Animal Spirits, I make bold to propound these Five Remarkables to you; The place of the Brain, wherein they are conceived, The Matter of which they are generated, The manner how they are propagated, The Subject in which they reside and act, and the uses of them.

The seat of
the Animal
Spirits.

As to the place in which they have their first Conception, there is a great controversy among the Masters of our Art, some placing it in the *Plexus Choroeides*, others in the Ventricles, a Third in the *Glandula Pinealis*; A Fourth in the external Arteries; And a Fifth in the substance of the Brain.

The seat of
the production
of Animal
Spirits, is the
Rete Mirabile;
according
to *Galen*.

Galenus sanguinem e corde prolatum, in reti mirabili fieri animale affert, e quo effundatur in Ventriculos. This minute Plexe of the *Rete mirabile* cannot furnish Blood enough (it being composed of small Carotides) to supply the Brain with so large a proportion of Animal Spirits, as are requisite to irradiate the great Orb of the Brain, and the numerous Nerves springing out of it.

Others place
it in the *Plexus Choroeides*.

Other eminent Physitians place it in the *Plexus Choroeides*, conceiving the Animal Spirits to be elaborated in it (which if true) doth suppose a separation of the serous parts of the Blood, (producing the Animal Spirits) from the Red Crassament; but the contrary is very evident to Sense, and Incision being made into the *Plexus Choroeides*, Blood immediately gusheth out, tinged with a perfect Red, no way inclining to an Albuminous Colour; the true hue of the nervous Liquor, plainly discernible in the substance of the Brain of Fishes and Birds, whose Brains upon Incision, are bedewed freely with Animal Juyces, distilling out of the wounded Fibrils of the Brain.

Others place
their Generation
in the
Ventricles of
the Brain.

Regius, Mercatus, Laurentius, Riolanus, and many Arabian Physitians, place the generation of the Animal Spirits in the Ventricles, those meaner chambers of the Brain. *Laurentius* speaking of the Animal Spirits, *Fit itaque in plexibus tantum preparatio, in ventriculis autem coctio, elaboratioq; alioqui frustra esse ut conditi sinus quatuor quos partes esse cerebri nobilissimas omnes admittant, quum ex eorum compressione & vulnere, precipitem mortem quotidie observamus.* If these Animal Spirits, consisting of volatil parts, should be formed in these Sinus of the Brain, they would be so unconfined in these larger rooms, where embodying with Air, they would soon exhale through the *Os Spongiosum*, and the freer Cavities of the Nostrils.

Learned

Learned Diemerbroeck giveth this account of a Student in Law, dead of a wound made in the Right Ventricle; Saith he, *Aperto prius Cranio, gladium ingressum fuisse orbitam unius oculi, in oculo nempe majori ipsi oculo tamen illaeso, & per superiorem dextrum Ventriculum penetrasse, hic tamen juvenis, nullis actionibus animalibus privatus fuit (quod certum indicium erat Spiritus e Ventriculo per latum vulnus effluxisse, mente sanus, bene videns, audiens, gustans, omnesq; partes bene movens, ac cum sociis convenienter & bono cum judicio quacunq; de re differens, vixit per decem dies, atq; tum supervenienti febre vehementiore, bidui spacio extinctus est.*

Ingenious Descartes his Opinion, is near akin to this, saying in his First Book *De Homine, circa finem.* Spiritus Animales per arteriolarum plexus Choroeidis angustias e sanguine arterioso separari in glandula pineali, atq; ex ea infundi in Ventriculos nec alio modo differre, a spiritibus vitalibus, quam sint tenuissima partes aliis separatae & alio duntaxat nomine donatae. If it were granted, (which is very improbable) That the Animal Spirits creeping through the small channels of the Plexus Choroeides, should be separated in the Glandula Pinealis; yet the acute Author would meet with a greater difficulty, how this very minute Gland, furnished only with a small Carotide branch, could propagate such a large store of Animal Spirits, to accommodate the large territory of the Brain, and the greater outlets of the Nerves derived from it, with which the Glandula Pinealis holdeth little or no correspondence, having only two small Nerves, peculiar to this Gland, which do no where perforate the Skull, as subservient to any other part.

And last of all, the Authors words do assert the Animal Spirits not to differ from the vital, being only thin Particles separated from them, and only called by another name; which Opinion (I humbly conceive) doth labour under great difficulties, because the Animal Spirits are of a different ingeny and disposition from the vital; these being of a more hot and sulphureous Nature, and the other consist of a more delicate gentle heat, and mild temper, founded in an Albuminous Matter, composed of temperate qualities, and soft saline Particles, seated in the more refined parts of the Animal Liquor, which is as much distinguishable from Blood, as the Red Crassament is from the serous Juyce, which is separated from the vital Liquor, not in the Glandula Pinealis, but in the Cortex of the Brain: And the Animal Spirits are not to be considered in an abstracted notion, as denuded from a Subject, but to be taken concretely as they involve a matter, with which they coexist; because the Animal Spirits are nothing but the most spirituous and active parts of the nervous Liquor, to which they are most intimately united, giving it vigor and perfection: After the same manner as the Spirit giveth life and briskness to Wine, without which it groweth faint and pawl, losing its gust, and usefulness, and name, being called no more truly *Vinum*, but *Vappa*; and as Blood being long extravasated, is bereaved of its nimble spirituous Particles, and degenerates into an earthy substance, at once losing its nature and name, and cannot be well called *Sanguis*, but *Cruor*; in like manner the Compage of the nervous Liquor being loosened, and the bond of mixtion untied, the tone of the Animal Liquor is wholly lost, when its noble, and generous vigorous parts, the Animal Spirits, quit their subject; so that the nervous Juice is turned into a Recrement at the approaches of death, at once giving a period to Sense and Motion, the sad effects of a Spiritless Animal Liquor, when it is not improved with store of milder, volatil salt, superabundant in the ambient parts of the Brain. Again, these serene lucid Particles, cannot formally reside in the dense opaque parts of the Blood, but in

The Animal Spirits are not generated in the Glandula Pinealis.

The Animal Spirits do not differ from the Vital, according to Descartes.

The Animal Spirits are the most refined Particles of the nervous Liquor.

the more Transparent Cristalline body of the nervous Liquor, highly exalted with most clear Particles of the Animal Spirits, do illustrate the Two Hemisphæres of the Brain, and the Nerves, streaming out of them with their brighter Rays.

Sylvius his Opinion, that the Animal Spirits are generated in the Cortical Vessels of the Brain.

Last of all, *Sylvius* in his Fourth Disputation, and the 25th Thesis, affirmeth the Animal Spirits to be elaborated in the vessels, branched through the ambient parts of the Brain, according to his own subsequent words, *Suspiciamus sanguinem a corde per Arterias, Carotides & cervicales sursum appellentem, partim transire in ipsam cerebri, cerebelliq; substantiam Medullarem ad eorundem vivificationem & nutritionem, partim secundum ipsorum superficiem deduci per ramos ipsarum Capillares ad Spirituum Animalium elaborationem*, which he farther explaineth in the 29th Thesis, *Suspiciamus præterea per Capillarum Arteriarum poros, penetrare sanguinis partem spirituosam in Cerebri, cerebelliq; corticem cinerum, hinc in mediam substantiam albicantem, atq; in hoc transitu liberari parte sui aquea, penitissime ipsi adhærente, non absimili modo illi, quo per spongiam Oleo imbutam, cerebri Medulla sub pingui hætenus Consimilem secernitur, & separatur uti loqui solent Chymici; rectificatur a suo phlegmate Spiritus vini purissimus, Spiritui Animalis natura sua proxime accedens.*

The Animal Spirits are the more mild parts of the nervous Liquor.

The manner how the Animal Spirits are generated.

And here I cannot but admire *Sylvius* his excellent simile, wherein he endeavoureth to illustrate the rare work of Nature in the production of Animal Spirits, by the ingenious Art of Chymistry, in drawing off the Spirit of Wine; but in this the witty Author seemeth to fail, in asserting the elaboration of the Animal Spirits to be performed, when the most spirituous part of the Blood insinuateth it self through the Pores of the capillary Arteries, into the Cortex, and thence into the Medulla of the Brain, where he saith it is separated from its watry parts by the unctuous substance of the Brain, and after the manner of the spirituous Particles of Wine drawn off from its Phlegme in distillation by a Sponge besprinkled with Oil, and may, saith he, nearly approach the nature of Animal Spirits, which are not (as I conceive, with this Learned Authors leave) the most spirituous sulphureous parts of the Blood, transmitted out of the capillary Arteries into the substance of the Cortex; but the more mild and delicate Particles of the serous Liquor, drawn off from the more fierce, sulphureous, Red, fibrous parts of the Blood, which are returned in circulation by the Jugulars; and the more gentle spirituous parts are left behind, being separated in the Interstices of the vessels of the cortical Glands, and thence transmitted into the extremities of the tender Fibrils, implanted into the Cortex. And this Discourse fairly bringeth me from the place, wherein the Animal Spirits take their first rise, to the manner how they are propagated by secretion, and to the *Materia substrata*, out of which they are generated, which is not the Purple Liquor, as it is highly concocted by great heat, and repeated circulations, whence it groweth exalted with quantities of hot oily qualities; or on the other side, for want of regular motion, and due heat, is depressed with Crudities growing gross with Recrements, or rendred acrimonious with fixed saline Parts, or depauperated by serous Fæculencies.

Wherefore the vital Liquor impelled out of the greater Cisterns of the Heart, into the lesser Channels of the ascendent Trunk of the Aorta, and thereby the more minute Rivulets of the carotide Arteries, are not only implanted into the Coats investing the Brain, but also into the substance of the cortical Glands, as so many Compages, made up of many distinct vessels of Arteries, Veins, and minute nervous Fibrils, interspersed with very many small spaces, interceding the Vessels; into which the Blood being transmitted, the more gentle

the Cristalline parts of the *Succus nutriticus*, impregnated with mild, volatil, saline Atomes, are secerned from the more fiery, sulphureous, and fixed Salt of the Red Crassament in the cortical Glands, which are so many Colatories of the Animal Liquor; so that the more refined parts of this choice *Succus*, are separated from the grosser and more adust parts of the Blood, which is performed in the ambient parts of the Brain, where this soft nervous Liquor meeteth with Air, first transmitted through the *Os Ethmoeides* into the Ventricles, and thence through the Pores of the *Medulla* into the secret passages of the Cortical Glands, in which the pure and subtle Particles of Air, do incorporate with the depurated *Succus Nutricius*, and highly attenuate it, rendering it more fluid and volatil, till at last the *Succus Nutricius* is more and more inspired with new spirituous æthereal Particles of Air, exalted with solar and other planetary influences, and is more and more impregnated with mild volatil Salt, imparted from the Cortical Glands; so that the more subtle, active Particles of this refined *Succus*, are called the Animal Spirits.

But some may enquire in what Subject these Animal Spirits are lodged. To which it may be replied, in the Nervous Liquor, which I conceive is not a subject of Inhesion, because the Animal Spirits do not exist in the nervous Liquor, *Tanquam accidens in subiecto, sed tanquam substantiale in substantiali, tanquam anima in corpore*, the Animal Spirits being the Form, and the Nervous Liquor the Matter, which receiveth its vigor and activity from them.

Learned *Diemerbroeck* denieth the very existence of the Nervous Liquor, and maketh the Animal Spirits to subsist of themselves separate from it. And according to this notion of the Animal Spirits, abstractly taken from any subject, he giveth this definition of them; *Sunt autem Spiritus Animales, halitus invisibiles, tenuissimi, ac volatiles, potissimum ex salsis sanguinis particulis, paucissimisq; sulphureis, maxime volatilibus in cerebro confecti*; Whereupon, according to this Learned Author, the Animal Spirits being most thin, invisible and volatil steams, and having no subject to confine their high volatility, their spirituous, subtle, airy Particles will easily insinuate themselves through the Interstices of the Vessels, seated in the Cortical Glands, and thence pass through the *Os Ethmoeides* into the Nostrils; wherefore to solve this and many other *Phænomena*, which may arise and perplex this improbable Opinion, I humbly conceive, (with the Authors pardon) that it is more reasonable to apprehend the Animal Spirits to be seated in the nervous Liquor, as their proper subject, in which they are confined, when they move from part to part within the Interstices of the Filaments, constituting the Nerves.

The Subject of Animal Spirits is the nervous Liquor.

The Animal Spirits do not subsist of themselves.

CHAP. XXXIX.

Of the Corpus Callosum.

The Corpus Callosum may be divided from the Cortex.

HAVING discoursed the Cortex of the Brain (and the Animal Liquor and Spirits generated in it) the next in order to be treated of is the *Corpus Callosum*, the more white and compact part, which according to *Baughin*, may be easily divided from the Cortex, in a Brain newly dissected after death.

The two Hemispheres of the Brain are united in the Corpus Callosum.

In the upper Surface of the Brain under the Sagittal Suture, is formed a great Fissure, in which is lodged the great Process of the *Dura Mater*, made of its Duplication, and like a middle Wall it rendreth an equal partition of the right from the left side of the Brain, dividing it into two Hemispheres, which unite themselves in the *Corpus Callosum*, and giveth a reception to every distinct Particle of the several *Anfractus* of the Brain, serving as it were for a Covering and Seeling for the *Fornix*, the *Medulla oblongata*, and its various Processes.

The Connexion of the Corpus Callosum. The rise of this Process.

This large Medullary Process is thick and deep in the fore part of the Brain, where it is affixed with two small Processes to the two Apices of the *Medulla oblongata*, called the Lentiform Processes, from which it is conceived to take its first rise, and extending it self toward the hinder part of the Brain, groweth thinner and thinner, at last closing with the *Caudex* of the *Medulla oblongata* by the interposition of thin Membranes and Vessels.

The Figure of the Corpus callosum.

The Figure of the *Corpus Callosum*, according to Learned *Vesalius*, is long and narrow, and hath in the upper part a very smooth Convex Surface, somewhat resembling the prominence of the top or sides of the Brain (but the lower Surface cannot be discovered except the left and right Ventricles be opened, and then the lower Surface hath a flexure all the length of the *Corpus Callosum*, and is not one and simple as the upper was, because to the length two Surfaces are drawn, hollowed like the fourth part of a Circle, and in the middle of these two Surfaces appeareth a *Tuberculum*, extended in the manner of a straight line, having a Convex Surface downward, by reason of its Prominence, and more and more contracting it self into a less compass, is called the *Septum lucidum*, parting the right and left Ventricles of the Brain, which is of the same substance with other parts of it, and is so thin and diaphanous in the middle, that if it be held up in a bright day the light may be discerned through it.

The Septum lucidum.

The use of the Corpus callosum.

In its upper Region it is joyned according to length to the *Corpus Callosum*, and in its lower to the *Fornix*.

The substance of the Corpus callosum.

The substance of the *Corpus Callosum* is a Compage made up of an innumerable company of white medullary oblong Bodies, which are streaky Filaments running cross-ways through its substance, plainly discernible when it is dissected long-ways.

As to the use of the *Corpus Callosum*, its great Office is to refine and advance the *Succus Nervosus* in its Circulation through it, and its mediation is a Base to unite the left and right Hemisphere of the Brain, and to propagate the *Septum lucidum*, and by its assistance the *Fornix* is kept up from compressing the Cavities of the Ventricles.

The

The *Corpus Callosum* in a Deer, is much different from that of Man, and consisteth of Two oblong Bodies, which are parted in their Origen, and are reflected towards the sides of the Brain, and encompass the terminations of the *Corpora striata*. Those oblong slender Bodies of the *Corpora Callosa* are parted in the middle with a long Fissure running all along the inside of them.

These *Corpora Callosa* begin in more acute, and end in more blunt Angles in the *Occiput*; But the *Corpus Callosum* of the Humane, and the Brains of other Animals, as far as I can discover, have a more plain Surface above, being endued with some small Prominence.

CHAP. XL.

Of the Ventricles of the Brain.

THE Ventricles † according to the received Opinion, are Four in number, but in truth are Two, as the most principal; the Right and Left Ventricle, Two large Perforations in the lower Region of the *Corpus Callosum*, bending with an unequal Magnitude, from the hinder part of the Brain, toward the Forehead, either Ventricle being more expanded towards the Origen, and more contracted toward the middle, and is affected with a blunt round Figure, which being carried with a Flexure, after a kind resemble a segment of a Circle, and are parted from each other in the midst, with a kind of transparent Wall, commonly called the *Septum Lucidum*, and in the upper and lower with the *Fornix*, and in their extremities, with larger proportions of the *Corpus callosum*.

The Two prime Ventricles are seated in the middle of the Brain, with a kind of æquidistance, in reference to the several Regions of it, both backward and forward, as to the *Occiput* and Forehead; and also upward and downward, in relation to the Vertex and Base of the Brain, and do perfectly agree with each other, both in Situation, Figure, Size, and Use.

A great part of the outside of these Ventricles are covered with a cineritious substance, commonly styled the *Cortex*, and is made up of a company of Arteries and Veins proceeding from the internal Carotides, and Jugulars, and principally from the great number of nervous Filaments. The upper part of the Ventricles passing the length of the Brain, almost from the Forehead to the *Occiput*, is smooth and even; but the lower Region of the Ventricles is carried obliquely forward toward the Cavity of both Ventricles, commonly called the Third Ventricle, being ready to receive the serous Matter transmitted to it; the Third Ventricle being reflected with the *Simis*, causeth a protuberance to be made both in the anterior and posterior parts of the lower sides of these Ventricles; and the Right is carried steeply down from the Right side to the Left, toward the common passage, in which both Ventricles are united, and the upper Regions of the Left and Right Ventricle are round, and severed by the *Speculum lucidum*; but the lower being continued all along with the *Corpus Callosum*, and *Fornix* (which I conceive to be a Process of it) do terminate into a common Duct, running under the

Fornix,

† T. 48. D.D.
† T. 44. A.A.
Four Ventricles of the Brain (as some will have it) but in truth are two principal ones.

The seat of the Ventricles.

The Ventricles run equal in reference to each other.

The Ventricles are severed from each other by the *Speculum Lucidum*.

Fornix, and do make a little Cavity or Ditch in the middle, for the descent of this Third Ventricle, compounded of the Two former, passing under the Arch of the *Fornix*, doth resemble a little oblong Ditch, passing between two small Hills.

The Third Ventricle.

The Third Ventricle being a common Cavity arising from the union of the Right and Left, is branched into Two small Cavities, and one proceeding from its lower Region, formeth an acute Angle; and though its whole length seemeth to represent an oblong little Trench, yet it tendeth straight downward towards the *Glans Pituitaria*.

The hinder Cavity is a part of the Third Ventricle.

But the other hinder Cavity is no small portion of the Third Ventricle, and passing down, between the *Testiform* and *Natiform* Processes, and upon the beginning of the *Medulla Spinalis*, bendeth backward to the Fourth Ventricle to which it referreth.

The beginning of this Cavity, saith Learned *Vesalins*, is not perfectly orbicular, but in some sort triangular; and in its lower part, keepeth the acute Angles of that Cavity from whence it proceedeth; but in the upper part, a transverse line may be seen, which uniteth both sides of that Angle, and with them maketh two other Angles.

The Fourth Ventricle. A *Sinus* called a Pen.

The Fourth Ventricle is last in Order, as well as Dignity, and is the least and the most solid, being a *Sinus*, passing between the *Cerebellum* and *Medulla Spinalis*, and being larger in the beginning, and growing less and less towards its termination, in a manner resembleth a Pen; from whence it is so called by *Herophylus*, and not without reason; for if you compare the *Sinus* with that part of the Pen we dip not into the Ink, you may mark the Orifice immediately above it, which is round, and it fitly answereth the end of the Cavity of the Third Ventricle; which is permanent under the *Natiform* Process, and then you may observe the print of the Pen, with which we write, to be like the lower part of the *Sinus*, where it hath a very small Cavity in that part of the *Medulla Spinalis*, when it taketh its leave of the Skull, and betaketh it self to the Spine: And the two Angles, which we apprehend to be made between the Point and the upper part, made for the holding of the Ink, and the sides of the Cavity, which you may discover to be most like to the sides of this *Sinus*.

The round Process to which the *Cerebellum* is affixed.

By the sides of the Cavity of the *Medulla Spinalis* where these Angles are made, is seated every way a round Process, to which the *Cerebellum* is fastned, and made contiguous to the *Medulla Spinalis*; so that the *Medulla Spinalis* formeth one part of the Fourth Ventricle; but the Cavity, which is seen in the *Cerebellum*, being shallow, and broader then long, is formed between the two orbicular Processes of the *Cerebellum*, by which it adhereth to the *Medulla Spinalis*, and between the part of the *Verniform* Process of the *Cerebellum*: And this maketh another part of the Ventricle, where it both in its anterior and posterior Region, is continued to the *Cerebrum* and *Cerebellum*; and where no part of the *Cerebellum* is, it is joyned to the *Spinalis Medulla*.

Though this Ventricle seemeth to be invested with a thin Membrane, both in the fore and hinder Region, and it is wrapped with it in its former, where it is conjoyned with the Brain, and the *Natiform* Processes. As also this Ventricle, is covered with a thin Membrane in its hinder Region, where the *Cerebellum* is contiguous to the *Spinalis Medulla*.

Renowned *Kerkingius* upon the Brain of one *Westphalus* a Natural, he saw the anterior Ventricles more then half full of salt Water, and found in the Right Ventricle a White Stone, that weighed Thirteen Grains:

This

This Salt Water (I conceive) proceeded from the Arterial Blood, and was transmitted from the Carotide Arteries of the *Plexus Choroeides*, into the Glands, and through them distilled into the Ventricles. As to the generation of the Stone, I conceive it was composed principally of fixed Salt mingled with an earthy Matter, and after concreted into a Stone, by the petrifying quality of the Salt Water, which is frequently found in Mineral waters, which have a disposition to petrify Wood, or any other Matter injected into them.

Salt water
found in the
Right Ven-
tricles.

The Antients assigned the use of the Chambers of the Brain to be a Mint, instituted by Nature for the Coining of the Animal Spirits; which being of a subtle spirituous substance, cannot at all be confined within the spacious territories of the Ventricles; Whereupon I humbly conceive it more consonant to Sense and Reason, that they are designed by Nature to be receptacles of serous Recrements (secernd from the mass of Blood in the Choroidal Glands) which distil through secret *Meatus* into the Cavity of the Ventricles, which discharge themselves either below, by the *Infundibulum*, into the *Glandula pituitaria*, and there received into the extremities of the Jugulars; or the Recrements are received above, out of the Ventricles into the mammillary Processes, and *Os spongiosum*, and so conveyed into the Cavities of the Nostrils.

Another use of the Chambers of the Brain, may be (as I imagine) to receive Air into their empty spaces, which may be thus disposed: The Air being first entertained in inspiration into the Cavities of the Nostrils; the greatest part is transmitted by holes leading into the mouth, and some airy Particles may ascend and pass through the *Os Colatorium*, into the larger Chambers of the Brain; and afterward the Air insinuateth it self into the Pores of the *Corpus callosum*, and other Medullary and Cortical Processes of the Brain; Which assertion may be founded upon this probable conjecture, by reason the Air, consisting of thin, fluid, elastick Particles, is always in motion, which naturally tendeth upward; whereupon it may be readily transmitted upward through the Nostrils, and Concave mammillary Processes, into the chambers of the Brain, and may thence be carried through small *Meatus* into its more inward Recesses, and ambient parts, which are made up of many Cortical Glands, composed of numerous Vessels of various kinds, in whose Interstices the more mild parts of the Serous Juyce being severed from the vital Liquor, are impregnated with volatil saline Particles, resident in the Cortical Glands, wherein the mild parts of the Blood enter into communion with the thin fluid Particles of Air, inspired with æthereal Atoms, streaming out of the lucide body of the Sun, and other Luminaries; whose benigne Influxes are displayed with the Rays of Light, into the subtle body of Air, disposing the Albuminous Liquor, as with a form in order to the generation of Animal Liquor and Spirits, by rendring them fit for the exercise of Life, Sense, Motion, and nourishment, which are the useful and noble instruments, made by the Omnipotent Agent, for the preservation and perfection of Humane Bodies.

C H A P. XLI.

Of the Choroeidal Plex.

The Plexus
Choroeides.
† T. 48. F. F.

The Plexus
Choroeides
is a System of
many parts.

The Origin
of this Plex.

The Mem-
branes of the
Choroeidal
Plex.

The Vessels
of thi Plex.

IN the Right and Left Chambers of the Brain, is lodged the *Plexus Choroeides* †, so styled from a kind of likeness the Membranes have to the *Chorion*, in which the Vessels and Glands are enwrapped, as in natural swadling Clouts, and is an aggregate Body compounded of Membranes, Glands, Arteries, Veins, and Lymphæducts too. If we may give credit to Learned *Steno*, which he affirmeth he saw in a Dissection; but other Learned Anatomists are of a different Opinion, asserting that the Ventricles supply the place of the Lymphæducts, exporting the *Lympha* distilling out of the Glands, into the next veins.

Most of the Antient and Modern Anatomists derive the Origin of the *Choroeidal plex*, from the forepart of the upper, and eminent Cavities of the Brain, thence creeping down into the Third Ventricle.

But it is more consonant to Reason, to fetch their rise, not from the Ventricles, but from the association of the Arteries, which is made near the *Glans Pinealis*, and not from the Fourth *Sinus*, seated under the *Crura* of the *For-nix*.

The *Plexus Choroeides*, having a broad beginning about the conjunction of the Arteries, which is continued a little space, and carried right forward about an inch, and then the Arteries part again, bending a little toward the Left and Right sides of the Brain; and a little after, the several portions of the Arteries creep into the Right and Left chambers of the Brain, and from thence are reflected from the sides of the *Septum lucidum*, toward the hinder part of the Ventricles, somewhat inclining outward, and being arrived thus farre, it returneth again to the former Region, encircling in its progress, the upper, lower, and outsides of the *Crura*, relating to the *Medulla oblongata*.

This Plex is formed of a Membrane, Vessels, and Glands, the Membrane is very thin and doth owe its rise to the *Pia Mater*, and is made upon this account, to keep the Vessels and Glands firm in their proper stations, lest they should straggle from each other, to their great prejudice.

The Vessels of which this Plexe is framed, are Arteries and Veins; *Riolan* affirmeth it to be formed only of Veins; and *Fallopins* of Arteries, which opposeth the circulation of the Blood, which then was not well understood; but since discovered by our Great Dr. *Harvey*, to his great Honour, and that of our Nation, and the advantage of Art; for Veins are of no use, where the Arteries are defective; and Arteries would prove destructive to the Body, if they were not attended with Veins; for the Arteries would transmit a quantity of Blood into the Membranes and substance of the Brain, and then if stagnant in the Membranes, would produce a *Phrenitis*, and high pains in the Head, caused by great Tensions: And if in the substance of the Brain, it would immediately produce an *Apoplexy*, and some other sleepy disaffections; so that to prevent these great Diseases, and to preserve the wonderful Oeconomy of Nature, the All-wise and powerful Creator, hath formed this Plex, which is a curious contexture of Arteries and Veins, entring into association one with another, that whatsoever superfluous Blood,

is brought in by the Carotide and Cervical Arteries, might be discharged by the jugular Veins, which challenge to themselves a different and threefold rise.

The First proceedeth from the anterior Branch of the Carotides, which espousing each other in mutual inosculation, do take their course toward the surface of the Brain, near the *Processus Mammillares*, and return back again under the *Processus Falciformes*, to the hinder region of the Brain, where they make diverse *Anastomoses*, with the branches of the Vertebral Arteries, out of which are propagated divers Branches into the *Plexus Choroeides* about the *Glans Pinealis*.

The First
rank of the
Choroeidal
Arteries,

The Second Classis of Arteries that contribute to the making up this admirable Plex, is derived from the posterior Branches of the Carotide Arteries, which being united to the Cervical, send forth a common Branch, which bending backward and outward, environeth in some part the *Medulla oblongata*.

The Second
Classis of Ar-
teries.

The Third rank of Arteries is derived here and there from diverse regions of the *Pia Mater*, and variously disseminated through the substance of the Brain, and inserted into diverse sides of this Plex, and do associate themselves with other Branches, and the Carotide and vertebral Arteries.

The Third
rank of Arter-
ies.

And this threefold Classis of Arteries is accompanied with variety of jugular Veins, which are very plainly discovered in two Trunks, bending down toward the *Coxarion*; These Capillaries are so small, that they can hardly be discerned in their first rise; but many uniting themselves in greater Branches, and arriving to the *Glans Pinealis*, do make up one Channel, firmly affixed to the Glands, and passing on a little farther, quitteth its name, and is called *Vas Venosum*, discharging it self into the Fourth *Sinus*.

The Arteries
are accompa-
nied with ju-
gular Veins
in the Cho-
roeidal Plex.

Sed quærat aliquis quodnam officium præstat Plexus Choroeides ut sanguis per tortuosos Plexus alveos placide permeans per Glandulas huic annexas a seroso latice secretus, in candidiori cerebri gremio aliquantulum reconderetur.

The use of
the Choroei-
dal Plex.

At cui usui dicantur hæ Glandulæ, ut Plexus hujus vasis appensæ, humores, in penitiora substantiæ Interstitia, trajectos, resorberent, donec illi angusta Glandularum loculamenta, nimia mole gravantes, ad ventriculorum specus, tanquam ad ampliora receptacula abligantur.

Natura artis æmula, in distillatione Chymica perficienda, plura vasa, variis destillandi usibus accommodat, primam liquoris aquosi facibus excipiendis apponitur, alterum autem instar recipientis cujusdam, spiritibus defæcatis extillantibus destinatur.

Deinde Plexus hic instituitur, ut motus sanguinis tot Mæandris præpeditus, arctioribus vasculorum Cancellis diutius immoretur, ut placide se in interiores cerebri recessus insinuet, ne præcipiti vortice præreptus, totam cerebri substantiam inundaret, a plexu autem hisce ventriculorum cameris hospitante ambientes cerebri ora mitius effervescentes, tanquam benigniori balnei Calore refocillantur.

C H A P. XLII.

Of the Fornix.

† T. 49. B. B.

THE Fornix † having a connexion with the *Corpus callosum*, by the interposition of the *Septum lucidum*) is a Medullary Process, deriving it self from the anterior part of the Brain, near the *Corpora striata*, and being stretched out under the Fissure of the Brain, immediately under the *Septum* (till it arriveth the hinder part of it) is conjoynd to the *Caudex* of the *Medulla oblongata* with two Processes, as with two stretched out Arms; and in its whole progress representeth a Triangle, compounded of unequal sides; The First and shortest is carried from the hinder region of the Right Ventricle, to the hinder region of the Left: The other side is placed in the Right Ventricle, and from the hinder region inclining inward, is extended to the anterior part of the Third Ventricle; And the Third side being placed in the Left Ventricle, agreeth in length with the former: The upper region that faceth the *Septum lucidum*, is gibbous, being invested with a Convex-surface, and the lower region of the *Fornix* is endued with a Concave, and Arched Surface, but the upper is different from it as somewhat prominent, and is united to the *Septum*, making a partition between the Right and Left Ventricles; in whose hinder region the *Fornix* is in a great part, somewhat orbicular, and seemeth in a manner to represent the Surface of an oblong Sphere; whereupon it hath imposed upon some to think them the round protuberancies, called by the Antients *Nates*.

The *Fornix* in its first rise hath two small white stalks, or Medullary Fibres, arising out of the *Corpus callosum*, and afterward do coalesce into one, about the *Processus lentiformes*, and make a broad Process, commonly stiled the *Fornix* (which doth support the chambers of the Brain) and being performed by the All-wise Architect after a triangular Figure, doth distinguish the large Cavity of the Brain into three partitions; whence arise the three Ventricles, of which the two first are the principal, and the third only a union of the two other.

The First and Second Ventricle pass down somewhat steep about the Base, and approaching one another, make a kind of Trench, upon which the *Fornix* passeth after the Figure of an Arch, and divideth the chambers of the Brain one from another, and sustaineth the soft Fabrick of the Brain, consisting of diverse loose pendulous Processes, and lest the weak sides should fall one upon another, whereby the various parts of this fluid Compage might quit their natural Positions, and start from each other in over-violent motions of the Head; Therefore for the better security of this noble structure, its several Processes are not only fastned to the *Medulla oblongata*, and *Cerebellum*, by the interposition of the *Pia Mater*, and its several Productions and Fibres, but also by the mediation of this medullary Process, commonly called the *Fornix*, which being extended from the fore to the hinder part of the Brain, preserveth it in its due Figure and Situation.

It is broad in its hinder region, and determines in its anterior, as it were into an Angle; and is somewhat like a Tripes, standing upon the substance of the Brain with three Legs, two of them bending downward toward the Base of

of the Brain; and the Third being united to the *Septum lucidum*, interposeth between the lower region of the anterior Ventricles, and extendeth it self forward toward the Nostrils, so that some, and not without some shew of Reason, have derived the Origen of the *Fornix* from them.

This admittable Process from its different Surfaces, and arched Figure, was called *Fornix* by the Antients, whose gibbous region above is overspread with numerous Fibres, which running overthwart in various Flexures, do make the Arch of the *Fornix*.

CHAP. XLIII.

Of the Corpora Striata.

THe *Corpora Striata* upon the Dissection of the Brain, seem to be lodged within the Ventricles; but upon a true inspection, are found to be seated without them; and I humbly conceive, that they are the Origen of the *Medulla oblongata*, whose Heads so incline one towards another, that they are almost conjoined; And from the Angles (by which they approach each other) the *Fornix* is derived with a double Origen. And the *Corpora Striata* seem to be united by a transverse Medullary Process; but their Terminations or lesser parts of these Lentiform Processes are more acute, being turned backward, and do after a manner form two sides of a Triangle, to whose anterior Surface the *Corpus Callosum* is conjoined for a good space.

When the Brain is Dissected, and so brought to a Plain, that the Lentiform Processes (being the tops of the *Medulla oblongata*) are laid bare, if you cut them in the middle (where they are fastned to the *Corpus Callosum*) you may plainly discover great variety of Streaks, making their progress several ways, upward and downward, forward and backward in parallel lines.

Dr. Willis, giveth a good description of the *Corpora Striata* in these words; *Ne quis dubitet quin istæ striæ, velut ductus sive canales, factæ à natura fuerint pro Spirituum Animalium è corpore Calloso in Medullam oblongatam, & contra ita redituq;* These Streaks of the *Corpora Striata* are formed by Nature, as so many Channels, for the free egress and regress of the Animal Spirits out of the *Corpus callosum* into the *Medulla oblongata*; And I conceive the *Corpora Striata* to be a texture of Vessels, and their Streaks to be so many Filaments, out of which it may seem probable, that the first rudiments and productions of the Olfactory and Ocular Nerves are formed, and afterward propagated to the *Medulla oblongata*, seated near the *Corpora Striata*: And it is farther conceived by Learned Dr. Walter Needham, that the *Corpora Striata* are the first Origen of the *Medulla spinalis*, a system of numerous nervous Filaments, the rudiments of the Vertebral and other Nerves, which receive their first rise and original from the *Medulla spinalis*.

The *Corpora Striata*, though they are outwardly invested with a white Membrane as with a fine Vail, yet they are rendred more beauteous within with a variegated substance, composed of White, streaked with Black, which give a mutual foil, as so many contrary Colours, sporting themselves as different Rays, illustrating each other.

The *Corpora Striata* are the Origen of the *Medulla oblongata*.

The Connexion of the *Corpora Striata*.

The Figure of the *Corpora Striata*.

The *Corpora Striata* are endued with variety of streaks.

The use of the *Corpora Striata*.

The Structure of the *Corpora Striata*.

The *Corpora Striata* are the Origen of the *Medulla spinalis*.

The Progress
of the Animal
Spirits accord-
ing to Dr.
Willis.

The Black is made up of a number of Filaments, and the White of a pulpy substance, interlining the vacuities of these oblong Fibres, which take their progress all along the length of the *Corpora Striata*: And according to Learned Dr. *Willis*, do run up and down, to and from the *Medulla oblongata*, as so many Channells, wherein the Animal Spirits are transmitted from the *Corpus callosum* to the *Corpora Striata*, and *Medulla oblongata*, and (as the Renowned Author will have it) from it to the *Corpus callosum*.

The outmost
Spirits have
no retrograde
motion in the
Brain.

This Hypothesis is grounded upon a conceived circulation of the *Succus Nutricius* in the Brain, but I most humbly conceive, with deference to the Excellent Author, that the Filaments do wholly descend from the *Corpus callosum* to the *Corpora Striata*, *Medulla oblongata*, and *Spinalis*; So that according to the Structure and Position of the Fibres, The Nervous Liquor (in which the Animal Spirits reside) streameth from the *Cortex*, through the various Medullary Processes to the Base of the Brain, and from thence hath no retrograde motion, by reason (as I conceive) the great design of Nature is to supply the Nerves springing from the *Medulla oblongata*, and *Spinalis*, with Animal Spirits and Liquor; So that all the numerous Nerves do receive their fruitful streams of *Succus Nutricius*, from the Brain, *Cerebellum*, and *Medulla spinalis*, as so many Fountains transmitting several Rivulets into the whole Body, giving Sense, Motion, and Nourishment (in some degree) to all parts, which do expend so large a proportion of Nervous Juice, that no superfluity is left in the Base of the Brain, and its adjacent parts, to supply a Retrograde motion (which if granted) would hinder the descending current of the Animal Liquor, and Spirits, toward the lower Region of the Brain. And the contrary descending and ascending streams of the *Succus Nervosus*, and its Spirits, would much impede, if not wholly obstruct each others opposite motions.

And furthermore, it is not needful that any return of the Nervous Liquor (impregnated with Animal Spirits) should be made from the Base of the Brain to the more inward Recesses and *Cortex*, when there is a production of Animal Liquor continually made out of the albuminous part of the Blood in the ambient parts of the Brain, and thence propagated downward to the several Medullary Processes to invigorate and nourish them, as they pass to the lower Region of the Brain, *Medulla spinalis*, and *Cerebellum*, to act the fruitful Nerves springing from them, with Spirits and Vigor.

CHAP.

C H A P. XLIV.

Of the Medulla Oblongata, and its appendant Processes.

HAVING treated of the *Cortex*, *Corpus callosum*, *Fornix*, the *Ventricles*, *Plexus Choroides*, and *Corpora Striata*, it follows in course that I should speak somewhat of the *Medulla* (seated in the Base of the Brain) and its appendant Processes.

To this eminent Process the *Corpus callosum* is conjoyned by the interposition of the *Corpora Striata*, and to its *Caudex* †, immediately.

The Connexion of the *Medulla oblongata*.

And also to it are appendant many smaller Processes, the *Thalami Nervorum Opticorum*, the *Natiform* to the Processes, and their *Protuberancies*, called *Testes*; and the *Pons Varolii*, or *Processus annularis*, which encircles the *Medulla oblongata*; And to the hinder part of it is appended the *Cerebellum*, and to its Anterior Region the *Brachia* of the *Fornix* embrace its *Crura* †.

† T. 48.

† T. 48. R. R.

The *Medulla oblongata* is of very great use by reason of the *Olfactory* and *Ocular Nerves*, the *Animastick*, *Motory*, and *Pathetick*, as also the *Par Vagum*, take their rise immediately from it; And the fifth, sixth, and seventh pair of *Nerves* from the *Annular Process*, affixed to the *Medulla oblongata*, which is derived from the *Corpora Striata*, as its first *Origen*, after which the *Crura* of this *Medulla*, proceeding apart a little space, do afterward coalesce into one *Trunk* composed of two *Branches*, which being conjoyned, do make the *Caudex* of the *Medulla oblongata*, whose whole progress both before and after the union of its *Crura*, is adorned with divers *Appendages*, and *Protuberancies*, and insertions of *Vessels*, which come out of all *Regions*, the top and bottom and sides of this noble Process, whereupon its Surface is rendred uneven with variety of Processes, and productions of *Vessels*.

Thalami Nervorum Opticorum.

† T. 48. & 49.

† T. 49. F. F.

The rise of the Optick Nerves.

Near the *Corpora Striata* are seated the *Thalami nervorum Opticorum* †, and are appendant to the *Medulla oblongata*, where its *Crura* do make unequal *Prominencies*, out of whose little *Mounts* do arise the *Optick Nerves*, and from thence bending forward in their circumference, and being carried somewhat downward, are conjoyned about the lower Region of the *Medulla oblongata*, and afterward parting again, do make their progress toward the *Orbite* of the *Eye*, as *Dr. Willis* hath well observed. And hereabouts the *Medulla oblongata* hath its *Crura* divided in *Man*, between which a kind of space or *Fissure* may be found, which hath an *Aperture* bending downward toward the *Infundibulum*.

From the same *Protuberancies* (from whence the *Optick Nerves* do derive their *Origens*) certain *Medullary Processes* do arise, and being carried on each side upon the brim of the second *Hole*, do unite about the *Root* of the *Glandula Pinealis*, these Processes Renowned *Dr. Cartes* conceived to be *Nerves* relating to the said *Gland*; but it is more probable that by these productions the *Optick Nerves* hold a mutual correspondence near their *Originations*.

The *Natiform* † and *Testiform* *Protuberancies* †, are endued with a kind of *Orbicular* or *Oval Figure*, and are so styled, because they seem (though in a lesser Model) to resemble the shape of the *Nates* and *Testes* of a *Man*.

† T. 49. & 50.

† 49. 66.

Some Anatomists make these continued parts of the Brain, but I conceive them more truly Processes severed from the Brain (by proper Membranes) and appended to the *Medulla oblongata*.

The Nativiform are larger than the Testiform Processes.

The Nativiform Processes do somewhat exceed the other in dimensions, but the difference is more conspicuous in other Animals (then in Man) because they appear larger in Hogs, Sheep, Calves, &c. And are not at all to be found in Birds, and Fish.

The coverings of the Nativiform and Testiform Processes.

These four Orbicular Prominencies are encircled with peculiar Membranes, (propagated from the *Pia Mater*) by which they are divided from the other Processes of the Brain, and are seated between the anterior region of the *Cerebellum*, and the posterior part of the third Ventricle, and do accrete to the upper region of the *Caudex* of the *Medulla oblongata*, which these Processes do cover about an inch, and are not contiguous to the Surface of it in the middle, because there passeth a Cavity under them during their whole progress they have with the *Medulla oblongata*.

The Colours of the inward Protuberancies.

The substance of these Processes in a Man, Dogs, and Cats, seem to be beautified with a whitish Colour like the *Medulla oblongata*, but according to *Vesalins*, it inclineth to Yellow; But these Protuberancies in Calves, Sheep, and Horses, are somewhat different from other parts of the Brain, as affected with a kind of Flesh Colour, which (I conceive) proceedeth from their thin Membranes overspread with numerous branches of Blood-vessels; But if you divest these Prominencies of their fine Membranes, their more inward substance seemeth to be hued with a Yellowish Colour, much different from that of the *Medulla oblongata*.

Some Physicians conceive the Nativiform and Testiform Processes to be the Origins of the *Cerebrum* and *Cerebellum*.

Some Anatomists are of an opinion, that those round Protuberancies are the Origins of the *Cerebrum* and *Cerebellum*, which being conjoined to them as so many *Crura*, to which on each side they are appended; And these Processes leaning to, and being afterward united, they conceive they constitute the *Medulla oblongata*; But this Conjecture (as I humbly conceive) hath more of Fancy than Truth, by reason the Brain is conjoined to the *Medulla oblongata* in other places before and without these round Processes, by whose mediation the Brain and *Cerebellum* hold no great intercourse, as being severed from each other by distinct Coats; So that if we seriously consider their situation and position in reference to the neighbouring parts, we may plainly perceive these minute Orbs do challenge to themselves peculiar Territories, distinct from the *Cerebrum*, *Cerebellum*, and *Medulla oblongata*, and these Processes are confined within proper Membranes, as so many distinct boundaries, and are parted from the Trunk of the *Medulla oblongata* by a Cavity running under the Nativiform and Testiform Processes.

The use of the Nativiform and Testiform Processes.

As to the use of these Prominencies, Learned *Bauhinus* saith, That they are designed as so many Pillars to support the loose Compag of the Brain, lest the passages leading out of the third into the fourth Ventricle, should be compressed, and the motion of the Animal Spirits intercepted: But with deference to this Learned Author, I humbly conceive this opinion is grounded upon a double improbability, First these small Processes are a more solid substance than the other parts of the Brain, which may be easily refuted by Sense; And the second improbability, supposing the Animal Spirits to be generated in the Ventricles, which cannot be granted in reason, because the Animal Spirits being of a thin and volatil Ingeny, if they had so large Chambers as the Ventricles, to converse in, would soon

Soon take their flight out of their Territories, and associate with the ambient Air.

Dr. Willis assigneth another use to these round Protuberancies, That the Animal Spirits, by the mediation of divers Medullary Processes might have an intercourse with the Brain and Cerebellum.

The second use of the Testiform and Testiform Processes.

And the Animal Spirits are associated, and as it were embodied in this double pair of Processes before they are imparted to, and converse with the neighbouring parts; According to the Learned Author; *At ille via propria, sive processus unus è Medulla oblongata in has prominentias ducere atq; alias ab iisdem abducere & illac in Cerebellum deferri videtur; hinc suspicari licet, quod Prominencia illa, presertim Natiformes (quæ principales sunt) diverticula quedam fuerint in quæ Spiritus Animales è Medulla oblongata in Cerebellum & vice versa in illam derivandi, secedant; & paulo infra subnectit; porro quoniam Spiritus Animales in utroq; promptuario, & in appendice resides, priusquam Cerebello inserantur invicem contundi & commisceri debent, idcirco pares utriusq; lateris prominencia, velut alis ad invicem exporrectis, mutuo coalescunt.*

Not far from these round Processes in the lower Region of the Medulla oblongata toward the Medulla Spinalis, is seated a small transverse Process, called Pons by Varolius, and he conceived it a part of the Cerebellum, Ita cerebellum prius ingentem sui sobolem transversalem, quem ille pontem Cerebelli appellans depromit. But it is more agreeable to Sense to call this transverse Process a part of the Medulla oblongata, to which are appended the Testiform Processes, and from which the Medullary Processes being derived, and carried up obliquely into the Cerebellum, near which other transverse Processes arise, and intersect the other, and are not inserted into the Caudex of the Medulla oblongata, but rather encircling it, do make the annular Process †, which is greater in Man than other Animals; and it is worthy our remark, that wheresoever the Natiform Process is large, as in Hogs, Sheep, and Calves, there the annular Process is small: But where the Nates are small, as in Man, there the annular Process is greater.

The Pons Varolii or Annular Process.

The Annular Process is a part of the Medulla oblongata.

† 7. 49. 1. 1.

The office or use of the Annular Process is to give the first Origins to the fifth, sixth, and seventh pair of Nerves; The Fifth takes its rise from the sides of the Pons Varolii, or Annular Process; The sixth pair of Nerves borrow their beginning from the lower Region of it; And the seventh pair being the Nerves of Hearing, are originally propagated from the lower side of this Annular Protuberance.

The use of the Annular Process.

The inferior Region of the Cerebellum being lifted up, the fourth Ventricle, less then the other, is offered to our view; which is made up of the Trunks of the Medulla Spinalis, the Cerebellum, and the Third Ventricle of the Brain at some distance, before they are united, by reason the upper and less part is made of the Sinus of the Cerebellum, covered with a fine Membrane, but the lower and more chief part seemeth to be engraven in the Medulla oblongata, endued with a Cavity resembling a Pen, whence it was called by the Antients, Calamus scriptorius.

The Fourth Ventricle of the Brain.

Some call this Cavity Ventriculum Nobilem, by reason (as they conceived) the Animals Spirits, first prepared in the upper Ventricles, receive their ultimate perfection in this, and from thence they do influence the Medulla Spinalis and Nerves; Which seemeth improbable, as it hath

hath been already discoursed in the use of the Ventricles, where we have made it appear, that they are receptacles of Excrements, and so inconsistent with the production of Animal Spirits, both in the anterior and inferior Ventricles.

CHAP. XLV.

Of the Glandula Pinealis.

The Glandula
Pinealis.

† T. 49. c.
The Figure of
the Glandula
Pinealis.

The seat of
this Gland.

THe Glandula Pinealis (as I conceive) is rather a small Process of the Brain than a true Gland, as being of the same Medullary substance with the Brain.

This Gland † hath the appellative of *Pinealis*, because it somewhat resembleth a Pine Nut, as being endued with an oblong Figure, whose Cone looketh upward toward the *Corpus callosum*, and its base downward toward the *Medulla oblongata*, and is seated in a Valley, passing between the Chambers of the Optick Nerves and the Natiform Processes; And near the hinder region of the *Fornix*, where the *Vas venosum* first proceedeth from the fourth *Sinus* of the *Dura Menynx* into the third Ventricle, leaning upon the most eminent and anterior part of the Testiform Processes.

This Gland in Man rather resteth upon those small Prominencies of the Brain, then by any continued substance is united to it, to which it is scarce fastned, as being separated by a thin Membrane, with which it is encircled, and is easily taken off in Dissection with the *Vas venosum*, under which it is placed: But in a Lamb, or Sheep, this Gland is not only conjoyned to the Brain, but seemeth to be one continued substance with it. And if you begin the Dissection from below, and first remove the *Cerebellum*, and the *Crura* of the *Medulla oblongata* being carried forward, the Glandula Pinealis may be seen in some part without, and in another between the Natiform Protuberancies.

The substance
of the Glandula
Pinealis.

The dimensions
of this
Gland.

The substance of this Gland is somewhat more solid then that of the Brain, and endued with a pale Colour, and enwrapped in a thin Membrane, derived from the *Pia Mater*.

This Gland is larger in Animals newly dead, and after some time groweth less, not as some vainly imagine, like Camphire exposed to the Air, dwindleth into Exhalation, or like Salt rendred liquescent in a moist *Menstruum*; but in truth it groweth smaller and more flaccid, by reason its excrementitious moisture is discharged into the neighbouring Veins.

The Vessels
of the Glandula
Pinealis.

This Gland is furnished with divers kinds of Vessels, Arteries, Veins, and Nerves, which Dr. Wharton calleth *Funiculos Nerueos*, on each side one, springing from the Origen of the *Medulla Spinalis* (from its *Crura*) where it is dispensed into this Gland: But in truth they are a pair of

of minute Nerves, deriving themselves from the upper Region of the *Medulla oblongata*, behind the Nativiform and Testiform Processes; And at last accompanying the motory Nerves of the Eyes, inserted into the *Musculus Troclearis*, and are called by Dr. Willis the Pathetick Nerves, giving various sparkling motions, caused by exorbitant positions.

Sylvius saith he hath often seen little Stones in this Gland; And Schuglius discovered a Stone filling up half the Gland; whereupon I humbly conceive the Gland grew Tumefied.

Learned Vesalius assigneth this use to the *Glandula Pinealis*: His words are these; *Ut (quemadmodum alia corporis Glandula) firmamentum esset vasi, quod tertium cerebri Ventriculum accedit, & ab ortu statim in frequentes ramos, tenui membrana contentos, dividitur, a presentiq; Glandula suffulcitur, ne dicti meatus principio, statim suo in cerebri cavitate ingressu, proxime incumbens eum obstrueret, animalemq; spiritum è tertio cerebri Ventriculo in quartum ferri prohiberet, sic ille: At tanti viri pace, hoc à vobis exoratum velim, ut opinionem nostram libere proferam: Glandula Pinealis (uti opinor) quum molliori compage donetur, non frequentibus vasorum ramulis stabiliendis; sed seroso humorum latici tum recipiendo tum secernendo inservit; Nec Glandula hæc aut spiritibus animalibus in Ventriculorum specubus elaborandis, aut eorum motui in iis promovendo, uspiam destinatur, quum subtilissimi isti spiritus amplioribus Ventriculorum cavernis libere pervagantes penitus avolarent, in ætherem cessuri.*

The use of the
Glandula Pine-
alis, according
to Vesalius.

CHAP.

C H A P. XLVI.

De Infundibulo.

The Tunnel
of the Brain.

THe *Infundibulum* borroweth its denomination from the likeness it hath with a Tunnel, whose upper part is of a larger circumference, and groweth lesser and lesser after, it descendeth lower and lower, ending almost in a Cone; But in truth if the *Infundibulum* be curiously viewed, the Cavity above is very little different from that below, running all along almost in an equal magnitude, for the *Infundibulum* is for the most part a narrow uniform passage of an Orbicular Figure, and hath been observed (though rarely) to be irregular, sometimes of acute and other times of obtuse Angles, arising out of the *Pia Mater*, where it investeth the Base of the Brain.

Plempius, hath observed it to be enwrapped in another most thin Membrane, of most acute sense, whence Learned *Sneider* is of an opinion, that no sharp Serous Recrements can be admitted into the *Infundibulum* without great molestation.

Its first origin is larger, placed near the Foramen of the third Ventricle, and is every way continued in its Medullary substance to the Foramen of the fourth Ventricle, being of the same dimensions with it, for the *Infundibulum* consisteth of a double substance, the first and outward is membranous, and the other somewhat medullary or pulpy.

Two White
Glands seated
near the end
of the *Infundibulum*.
The use of the
Glands.

About the middle region of the *Infundibulum* are seated two whitish Glands in Humane Brains, but in Brutes only one, but far exceeding the other in magnitude, and seem to be constituted on this account instead of two soft Pillows made to secure the thin tender Membrane of the *Infundibulum* to rest upon, and to conserve it in its proper place on the one side, being supported on the other by the united *Caudex* of the Optick Nerves.

The end of
the *Infundibulum*.

But it may be demanded to what end serveth the *Infundibulum*? To receive the Recrements transmitted from the Brain and *Cerebellum* to the four Ventricles, and thence to convey them to the *Glandula Pituitaria*.

But it may be farther enquired after what manner and ways the Serous Superfluities are communicated to the Chambers of the Brain, and from thence to the *Infundibulum*? To which this reply may be made, That the Brain and *Cerebellum* and Glands of the Plexes are so many Colatories of the Blood, by which it is depurated from its *Fæces*, which afterward distill into the Ventricles, and *Infundibulum*, which is effected first as to the Brain after this manner, In Hydropick and moist Bodies, the Blood being depraved with Serous Liquors, is carried by the Carotides into the substance of the Cortex, whose Glands do not only separate the more soft part of the Vital Liquor, and convey it into the Extremities of the Fibres, but in case of any exigence, do make a secretion (as I conceive) of the watry *Fæculencies*, and transmit them through the secret *Meatus* of the Cortex and *Corpus Callosum*, into the Ven-

Ventricles, as so many Cisterns of watry humors which discharge themselves by the *Infundibulum*, as a common Pipe into the *Glandula Pituitaria*.

The other Colatories by which Nature defæcates the Blood; are the innumerable Glands interwoven with Arteries and Veins in the *Plexus Chorooides*, into which a large source of Blood is impelled by the Carotide and Vertebral Arteries, whose smaller Branches being inserted into the numerous Chorooidal Glands, do transmit in Hydropick Constitutions, great quantities of Serous Blood into the substance of them, where a Percolation is made of the watry Saline, from the more pure and Alimentary parts of the Blood; and if the Serous are so Luxuriant, that they cannot be entertained into the small Extremities of the Jugulars, the body of the Glands grow immediately swelled, and the watry Recrements having more and more recourse to the Ambient parts of the Glands, do force their way through the small insensible *Meatus* of the Membranes, encircling the Glands, into the Cavities of the Ventricles, as so many dreins of the Brain, and are thence derived to the *Infundibulum*, and *Glandula Pituitaria*.

Innumerable
Glands in the
Plexus Chorooides.

After the same manner the Blood is refined in the *Cerebellum*, which being dispensed by the Vertebral Arteries into an eminent Plex, is seated in the *Cerebellum*, is thence derived by smaller Branches implanted into fruitful small Glands †, in whose substance the Serous being streined from the more nourishing Particles, and if the Watry Humors are so exuberant, that they cannot be returned by the Veins, Nature findeth out another way to free it self from its burden through the secret passages of the Coates enwrapping the Glands into the fourth Ventricle neighbouring upon the Confines of the *Cerebellum*.

Fruitful
Glands in the
Cerebellum.

† kkk

C H A P. XLVII.

De Glandula Pituitaria.

The seat of
the Glandula
pituitaria.

THE Glandula Pituitaria is lodged within the Cavity of the Sella Equina, without the verge of the Dura Menynx, which notwithstanding is fixed to the Processes of the Os Sphenoides before and behind, to render the situation of it more firm. And the Dura Mater descending to the Glandula Pituitaria, covereth its upper region, only giving way to the passage of the Infundibulum.

The Figure
of the Glandula
pituitaria.

Its Figure is somewhat depressed, Concave above, and Convex below, and in some sort Quadrangular in its circumference, borrowing its shape from the Sella Equina, in which it is enclioistred.

The substance of this Gland is more solid then that of other Glands, and is enwrapped in a thin Membrane, propagated from the Pia Mater, and derived immediately from the Infundibulum, expanding it self about this Gland, by whose mediation it is tied to the sides of the Sella Equina, in Hogs, Calves, Sheep, and the like, and is not so firmly fixed in Cats, Conies, and Dogs, in which the Glandula pituitaria is easily parted from the Sella Equina, by pulling the Infundibulum out of his proper place: This Gland is furnished with small branches of Arteries, springing out of the Trunk of the Carotides (while they ascend each side of it to the Brain) and Veins from the Jugulars.

The uses of
these Glands.

As to the uses of those Glands, there are various opinions, Bauhinus giveth his, that it receiveth Recrements from the Brain, and dischargeth it again into the Palate, by Four holes engraven in the Skull, which seemeth very improbable; there being as yet no excretory vessel discovered in the Glands pituitaria, through which the Recrements may be transmitted into those Foramina, terminating into the Palate.

The use of the
Glands pituitaria.

Learned Dr. Wharton assigneth this use of it, to entertain the serous humidities of the Brain, and to reconvey them into the Plexus retiformis, and Third pair of Nerves into the Tonsils, and Glands of the Eyes, and maxillary Glands, The Authors words are these in his Fourth Chapter, *De Glandula Pituitaria, Superflua cerebri humiditates quanquam seipsa excrementosæ reputandæ sint respectu ipsius cerebri, respectu tamen aliarum partium aliquid Succu nutritii in se continere possint, & muneris hujus Parenchymatis est illum Succum nutritium a parte excrementitia secernere, sed quo transferat selectum hunc succum, nimirum in Plexus retiformes nervorum sibi connexos, indeque per nervos alios distribuitur in partes, quibus usus est, quid autem sit de materia excrementitia, dico eam per minuta foramina, animalibus facile conspicienda in parte Glandulæ posteriori sita excerni, & a posteriori Sellæ Equinæ parte utrinq; delabi, ad Fibrarum filamenta; Sive Fibrosum, laxumque tuniculum tertii paris mox ab egressu ejusdem a crassa meninge, cujus spongiosis & peramplis ibi loci ramis, credibile est hæc humiditates imbibi, & transferri vel ad oculos, vel tonsillas, vel Glandulas maxillares, quarum ope hæc omnes prout earum natura postulat, humectantur: Saith the Learned Author, though the unprofitable Humidities of the Brain, may be esteemed excrementitious in reference to the Brain; yet in relation to other parts, they may preserve in them some Alimentary Liquor; These words*

words are not without weight, and clearness; but the subsequent are more perplexed, *Munus Parenchymatis esse, illum succum nutritivum a parte excrementitia secernere & in plexus nervorum retiformes transferre*; and so on as above. As to the First, it is difficult to understand how a Secretion shall be made of the *Succus nutritivus* in so small a part as the *Glans pituitaria*, not exceeding the greatness of a Pea: And therefore I humbly conceive, that the Secretion is made above in the Brain in the *Plexus Choroeides*, in the substance of those numerous Glands, and thence exonerated into the Ventricles, from whence it sometime distilleth through the *Infundibulum* into the *Glans pituitaria*; but if it should be granted that a separation be made in the body of the *Glans pituitaria*; how then shall the *Succus nutritivus* be disposed of, saith the Author? it may be transmitted into the *Plexus retiformis*; but this is very difficult to understand, unless the *Plexus retiformis* take its rise from the *Glans pituitaria*, and then the *Succus nutritivus* be entertained into its extremities, but the *Plexus* deriveth it self higher from the *Medulla oblongata*, and only propagateth some branches into the *Glans pituitaria*, which are inserted into its substance, and so this Learned Author might conceive the *Succus nutritivus*, separated from the excrementitious part, might be conveyed into the terminations of the nervous Fibrils, appertaining to the *Plexus retiformis*, which seemeth very strange, because the constant stream (as I conceive) of the *Succus nervosus*, distilling from the Brain down, and between the filaments of the Nerves, must necessarily give a check to this retrograde motion of the *Succus nutritivus*; but suppose it be made in the *Glans pituitaria*, and the separated Liquor be conveyed into the *Plexus retiformis* (which I have shewed to be very improbable) what then shall become of the excrementitious Particles, drawn off from the Alimentary? Saith the Author, they may be received into the Filaments of the Third pair of Nerves, which is as difficult to be apprehended as the former, and encountreth the same perplexity, seeing the Third pair, doth not arise out of the *Glans pituitaria*, but out of the sides of the *Processus annularis*; and it may be farther objected, that the excrementitious parts abstracted from the *Nutritivus*, in the body of the conglobated Glands (among which the *Glans Pituitaria* is to be ranked) is not to be transmitted into the Nerves, but into the Lymphæducts or Veins.

Diemerbroeck giveth his sense in the use of this Gland, in the First Book of his Anatomy, and Eighth Chapter, *Verior hujus Glandulae usus inveniendus est, qui non est petuitam e medio cerebri ventriculo excipere, sed potius ex arterialis retis mirabilis serosæ pituitæ partem separare, & per ei desuper impositum infundibulum ad medium ventriculum transmittere, & inde ad anteriores Sinus & superiores ventriculos procedens per processus papillares, effluat ad nares & palatum.*

Diemerbroeck's
Opinion concerning the
use of this
Gland.

This Opinion I humbly conceive is not suitable to the situation of the *Glans pituitaria*, which being lodged under the Brain, in a Cavity of the *Sella Equina*, should then make a separation of the purer parts of the Blood from the impure, and thence transmit the serous Liquor upward through the *Infundibulum* into the Ventricles of the Brain, which runneth counter to the course of Nature, that Liquor being a heavy Body should ascend, and being effected without pulsion, and then one part of the Liquor should press the other forward, by the brisk contraction of the *Infundibulum*, of which motion it is no way capable, as being destitute of fleshy Fibres; But the Learned Author conceiveth he hath found out an expedient for this, though the *Infundibulum* hath no voluntary motions acted by Muscles, or fleshy Fibres, yet it may have a natural motion proceedin from the dilatation and coincidence

of

of the Brain; *Nam cerebrum inquit ille alternata sua dilatatione, & concidentia quosq; intra cranium contentos humores per vias singulis destinatas, & inter alios etiam serosam pituitam, & dicta Glandula clementer promovet sursum.* But if the Brain were capable of these motions of Dilatation and Concidence, (which the most Learned Anatomists do doubt) yet they can have no influence upon the *Glans pituitaria*, it being lodged without the verge of the Brain in a peculiar Cavity, in the *Sella Equina*, to which it is firmly affixed.

And if these motions of the Brain should be supposed, yet they would not move the serous Recrements from the *Glans pituitaria*, through the *Infundibulum* upward into the Ventricles of the Brain, but only gently promote the course of the nervous Liquor downward from the *Cortex* into the nervous Fibres, and afterward into the *Corpus callosum*, and *Medulla oblongata*; and also the defluxion of the serous Liquor out of the *Chorooidal* Glands, into the ventricles of the Brain, and thence down through the *Infundibulum*, inserted into the *Glans pituitaria*, and not from the *Glans pituitaria*, into the *Infundibulum* and Ventricles, and from thence into the Nostrils and Palate, which is (as I conceive) a far-fetched, unnatural, and preposterous motion.

Another use
of the *Glans*
pituitaria.

But I conceive another use may be assigned to the *Glans pituitaria*, with greater probability than the former, as being more agreeable to the structure and position of the *Glans pituitaria*, and other parts of the Brain relating to it, that the serous Humors should distill out of the substance of the Brain, and *Chorooidal* Glands into the Ventricles, and descend by the *Infundibulum*, into the *Glans pituitaria*, and thence be carried, not into the Palate (as the antient Anatomists would have it) because this Gland hath no excretory vessel leading into the Cavity of the Nostrils, and Mouth, but into the neighbouring jugular Veins, returning the Blood in its circulation; by reason these Recrements of the Brain, contain some Alimentary Liquor (impregnated with volatil Salt, in the substance of the Brain) whereby the mass of Blood running to the Heart receiveth an improvement.

C H A P.

C H A P. XL VII.

De Rete Mirabili.

THE *Rete Mirabile* is so entitled from the great variety of Carotide Arteries, and Jugular Veins climbing up, and creeping down the sides of the *Sella Equina*, and the vessels so variously meeting and inosculating with each other in such order, as they resemble a kind of fine Network, very pleasant to behold.

The reason of the denomination of the *Rete mirabile*.

This Plex of Vessels is of different Dimensions in diverse Animals, larger in some, according to the number of Arteries, frequently accosting each other upon the sides of the *Sella Equina*, and then parting with its Walls, runneth transversely into the substance of the *Glans pituitaria*, whose Body is enlarged or lessened, as it receiveth greater or lesser number of Vessels, derived from the sides of the *Sella Equina*.

This Plex hath different dimensions.

In a Man or Horse is discovered a small or no *Rete mirabile*, and therefore in them the Arteries do wheel within the Recesses of the *Sella Equina*, making few inosculations, causing little or no Network, and out of the Trunk conveyed in peculiar Channels, ten Branches are emitted into the body of the *Glans pituitaria*, whence ariseth the smallness of it in Men and Horses.

The *Rete mirabile* is very small in Man.

In Calves, Foxes, Sheep, Red and Fallow Deer, and diverse other small Animals, the *Carotis* seated on either side within the *Cranium*, under the *Dura Mater*, groweth fruitful in numerous minute branches, which are interspersed with various Nerves, issuing from the Fifth pair, and some Veins springing from the descendent internal Jugulars. This multiplicity of small vessels doth frequently unite and part again, winding up and down in such various positions, that they seem to resemble diverse small Nets lying one upon another, yet not so, as to be parted.

The *Rete mirabile* in Beasts is derived from the Carotide Arteries and jugular Veins.

And this admirable frame of minute Arteries, Veins, and nervous Fibres, is so finely divaricated, that it is not unlike a skain of Silk, consisting of diverse complications; and it may be worth our notice, by how much the greater the *Rete mirabile* is, the Plexes of Arteries in one side have more large and numerous Inosculations with the Plexes of the other, transmitting from each side of the *Sella Equina*, greater and more fruitful Branches into the *Glans pituitaria*; The verity of it is easily evinced by the experiment of injecting some Black Liquor into the Trunk of the Carotide Artery, seated in the Neck, and the Vessels or Plexes of both sides will be speedily tinged with the same Black hue, and the Trunk of the opposite Artery being wounded, the Black Liquor will freely distil out of it, which plainly discovereth the Plexes of one side communicate with the other by frequent Inosculations, so that the Carotide Arteries being laid bare for an inch or two, that the Trunks may be viewed on both sides of the Neck at the same time, and diverse injections being made upward into one only Trunk, you may plainly discern in the tincture, to descend from one side, far down into the Trunk of the opposite Artery, while in the mean time little or no part of the Black Liquor is transmitted into the jugular Veins; And afterward the Head being opened, all the Arteries may be seen to be tinged, near the confines of the Head; as also the arterial

The Plexes of Arteries shew many Inosculations with each other.

The passage
of the Blood
through the
Brain into the
Jugulars.

terial branches, that do compose the *Rete mirabile*, and thence do climb up the Base of the Brain, are infected with the same hue. And this I conceive to be the reason why the Liquor is sooner transmitted into the opposite Artery, then into the jugular Vein, because it cannot be received into the Veins, until its passage through the several regions of the Brain be first admitted into the Veins, leading into the *Sinus*, and thence re-conveyed into the Jugulars; wherefore the Liquor injected into one Artery, is more readily received into the opposite Artery (one side communicating with another, by diverse Inosculation) then by too long a circuit of the Brain, before it can be transferred into the *Sinus* and jugular Veins.

The use of
the mutual
Inosculations
of Arteries.

Wherefore we should with all Thankfulness and Reverence admire that Divine Hand, who dispenseth the Blood within the confines of the Brain, with such Goodness and Wisdom, not any ways parallel'd by Art, because the Carotide Arteries holding intercourse one with another, by mutual Inosculation, do speak a double advantage, because in one and the same method, its provided on one side, that the Brain should not be robbed of its due tribute of Blood; and on the other, that it should not be killed with kindness, as overflown with too hasty a current. As to the First, the use of the opposite Arterial Branches entertaining correspondence with each other by mutual Inosculation is this, If it should happen, that the Carotide Branches should be stopped in one side of the Neck, the Brain notwithstanding may be well supplied with Blood, imparted to it by the opposite Arteries of the other; And as to the Second advantage, If the Blood should be carried upward with an impetuous manner, threatening an inundation of the Brain, Nature hath most wisely provided by diverse currents, to divide the great violent stream by various opposite Arteries, propagated by Inosculation from one side to the other, to divert the over-hasty torrent of Blood, thereby anticipating the overflowing of the Brain.

CHAP.

C H A P. XLVII.

De Cerebello.

TH E *Cerebellum* is so styled by the Antients, as if it were a diminutive Brain; the Brain being the greater Metropolis, and the *Cerebellum* but a petty Corporation, yet it hath municipal Rights, and peculiar privileges and perfections, as a distinct Body from that of the Brain, and is lodged in the lower and hinder part of the Skull, within the large *Sinus* of the *Occiput*, and in Brutes filleth up almost all the *Occiput*.

The *Cerebellum* hath a broadish depressed Form, and on both sides doth resemble a Globe, or rather two Globes clapt together, and not endued with one plain entire Figure, but many divisions and unevennesses, in which Nature seemeth to sport it self with great variety of Ridges and Furrows, Rises and Falls, Hills and Dales, in which the numerous Plexes of Arteries and Veins lye intrenched, to fortify themselves against outward Assaults of Strokes and Falls, to prevent the ill accidents of Contusions and Lacerations.

The Brain is variegated with irregular *Anfractus*, but the *Cerebellum* is ranged with more uniform ranks of *Lamellæ* † adorning its surface in parallel lines.

Its former and latter region is determined into the *Processus Vermiformis* † and the little Circles, and as they approach these terms, as in the two Poles, are most short; and from thence as they approach the top, as to the *Æquator*, the parallel Lines grow longer in the Sphære. These *Lamellæ* as they confine on the Surface are Cortical, and of a cineritious colour, but the more inward are Medullary, being of a Whiter hue; And these Cortical and Medullary little Circles are so variegated and intermingled with each other, that it is very difficult, if not impossible to part them; These Medullary Veins resolve themselves on both sides of the *Cerebellum*, into two large *Meditullia*, which are of the same colour, but somewhat of a more solid substance than the *Corpus callosum* of the Brain.

The *Cerebellum* in some Animals is composed of an orderly Fabrick, one part exactly answering another in uniformity, and all the *Lamellæ* running about the Surface of the *Cerebellum* in a parallel manner, observe the same distance and proportion; But in other Animals, there be *Globuli*, as it were *Episphæres*, adorned with lesser Circles, which are fastened to a prime Sphære, beautified with greater Circles within; and the smaller Circles may be called Excentrick, as the *Lamellæ* are disposed in a different Series from those great ones of the *Cerebellum*.

The *Cerebellum* is a Compagely finely made up of a great number of Arteries springing from the Vertebral, and Veins from the Jugular; these vessels are seated for their better security, in the Interstices of the *Lamellæ*, and being curiously branched through the *Pia Mater*, do oftentimes acost each other, being interwovenlike Net-work, and at last do terminate into the Fourth *Sinus*.

This rare structure is not only composed of Arteries and Veins, but also of innumerable company of nervous Fibrils, as so many *Lamina* or Layings, placed in excellent order one by another, ending toward the confines of the *Cerebellum*,

The *Cerebellum* seemeth to be a little Brain.

The Figure of the *Cerebellum*.

The unevennesses of the *Cerebellum*.

The *Lamellæ* of the *Cerebellum*.

† T. 50. F. 1. 88888.

The *Processus Vermiformis* of the *Cerebellum*.

† T. 50. F. 1. a. a.

The colour of the *Lamellæ*.

The orderly progress of the *Lamellæ* in some Animals, and irregular in others.

The vessels of the *Cerebellum*.

The nervous
Fibrils of the
Cerebellum
resembleth a
Tree.

Cerebellum, in which they are more eminent then in the Brain, and present us with a pleasant prospect, representing a fine Landscip, consisting of many different Divarications, resembling a Tree, having several Ramifications and Expansions of Frondage and Foliage, one sprouting out of another, the smaller out of greater Fibres out of Stalks, Stalks out of Twigs, Twigs out of Boughs, Boughs out of Arms, and Arms out of Trunks. The Trunks and Bodies of Nerves belonging to the *Cerebellum*, are planted in the *Processus annularis*, and *Medulla Spinalis*; These Trunks being composed of numerous Fibrils, divaricated through the substance of the *Medulla*, of the *Cerebellum*, do derive themselves from the *Cortex*, as so many Roots, out of which the innumerable Branches of nervous Filaments do spring.

The lateral
part of it,
resembling
two Globes.

The structure of the *Cerebellum* is framed of two lateral parts, somewhat resembling two Globes joyned together, and confining on the *Processus Vermiformis*, which consisting of diverse transverse and winding Particles, united with a thin Membrane, do in some sort represent Worms, frequenting rotten Wood, from whence they borrow their denomination of *Processus Vermiformis*. The Anterior of these being protuberant in the Fourth Ventricle, adjoyneth to the *Processus Nativiformis* of the Brain; but the Posterior part of the *Processus Vermiformis* by reason of its blunt point, doth terminate into the substance of the *Cerebellum*.

The Distention
and Contraction
of the *Processus*
Vermiformis.

Some Physicians are of an Opinion, but upon what account I cannot conjecture, that this Process is distended, and contracted upon the elevation and depression of the *Cerebellum*. The *Cerebellum* hath no Ventricles, no *Plexus Choroides* (passing the length of their Cavities) but hath somewhat resembling that Plex, made up of many vertebral Arteries, and Jugular Veins, beset with diverse Glands somewhat larger then those of the *Plexus Choroides*, so that these Vessels, accompanied with numerous minute Glands, are rendered conspicuous, when the *Cerebellum* is divested of the *Pia Mater*; and then on either side of the *Processus Vermiformis* may be discovered Branches creeping upward, and springing from the vertebral Artery, lodged under the lower Region of the *Medulla oblongata*, and the jugular Veins transmitted from each lateral *Sinus*.

The *Cerebellum*
is beset
with many
Glands.

The use of these Arteries and Veins seated in the whole Compage, but principally in the hinder part of the *Cerebellum*, I conjecture to be this, that the more serous part of the Blood might be protruded through the extremities of the Capillary Arteries, into the substance of the Glands; and the more watry Recrements might be received into the Veins, and pass toward the Heart in the circulation; But if there be so great a quantity of serous Liquor, separated in the substance of the Glands, that it cannot be re-conveyed into the small extremities of the Jugulars, it exudeth (as I conceive) and distilleth into the Fourth Ventricle, lying under the Processes of the *Cerebellum*, and *Caudex* of the *Medulla oblongata*, and is from thence conveyed through the *Cerebellum*, which is very much smaller near its union with the Brain, and may be styled the Neck of it, where it hath its Origins † and is there more protuberant then in its Posterior Regions, which grow more and more enlarged as they approach the terminations † of it, where the *Lamellæ* are greatest, and are more and more lessened as they tend to the Origins of it.

The uses of
the Arteries
and Veins of
the *Cerebellum*.

The Neck of
the *Cerebellum*
† T. 50. F. 1.
bb.

† ii.

† T. 50. F. 1.
bbb.

† ccc.

† ddd.

† eee.

The *Cerebellum* consisteth of Two great Provinces † seated on each side of the middle protuberance, and each of these Provinces, may be divided into Three lesser Circuits, or Stories, the greatest of them † is next the termination, and the middle † is smaller then the Posterior, and greater then the Anterior, or highest Apartment †.

These

These several stories of each lateral Fabrick, † may be distinguished by their various protuberancies; the Posterior being the most depressed, and the Anterior most prominent, and the middle of a middle nature, more protuberant than the Posterior, and more depressed than the Anterior.

And although the denomination speaketh a diminution, in reference to its slender bulk, yet it may in some sort challenge to its self preheminance above the Brain, in relation to the curious Fabrick of its Cortex; that of the Brain being framed of diverse *Anfractus* or *Mæanders*; but this of the *Cerebellum* is beautified with an innumerable company of Processes, embellished with variety of fine Models of different shapes and sizes, some resembling in a manner Triangles, others Quadrangles of unequal sides, Ovals, and others, are Orbicular, or Pyramidal.

The Protuberance seated in the middle of the two lateral Provinces, is bigger near the Origen, growing less and less towards the Extremity, and is beautified with numerous Processes, styled *Vermiform*, † because they wriggle up and down in their Figures, like those winding holes, perforated in rotten wood by Worms.

These Processes are oblong and slender, making many oblique and transverse passages to and fro in delightful *Mæanders*.

Birds have one only oblong and round Protuberance, somewhat like the middle in Man, and are destitute of the lateral Provinces.

This oblong Prominence in Fowl, is garnished with many transverse and oblique Processes passing cross-ways, and do somewhat emulate the *Vermiform* Processes of a humane Brain.

The *Cerebellum* in more perfect Animals, as a Doe, Calf, Lamb, and less perfect, as a Hare, Rabbit, and the like, somewhat resemble that of Man in the middle protuberance, as guarded on each side with lateral Provinces, which are adorned only in Brutes with thin ranks; that next to the margent of the middle Prominence is the greatest, and consisteth of oblong slender Processes, and the Second and Third rows in a Doe, and the like, are made up of shorter Processes, somewhat tending to Oval; but most are of irregular Figures, very difficult to describe.

But the lateral Provinces in Man, are beautified with more ranks than Brutes, which are much less in compass, and begin in large Bases, and end in a kind of Cone, contrary to those of Man, which begin in small necks, and have greater terminations.

The more perfect Animals differ also in the *Cerebellum* from that of Man, in that they are destitute of all *Lamellæ*, consisting of greater and less semicircles, seated in the lateral Province; but Coneys have *Lamellæ* in the middle Prominence, whereas Men have them in the lateral Apartments. And the middle Protuberance in a Hare hath a Red line, intersecting the transverse and oblique Processes the whole length of the Prominence, which is rare in any other creatures.

And Coneys have fewer lateral Prominencies than Hares, the First having but One rank, and the other Two or Three ranks of minute Processes.

And these various Processes are not only lodged in diverse ranks, in the ambient parts of the *Cerebellum*, but also in the more inward Recesses, which I plainly discerned in the dissecting the *Cerebellum* of a Lamb; wherein I saw the arrangements of Processes lye two or three deep one under another, one being united to the other in some parts, by thin Membranes, and then under one to the two large *Mediullia* of the *Cerebellum*.

The Processes of the *Cerebellum* are endued with diverse shapes and sizes. † AA.

Brutes have fewer Processes which have a different progress from those of Man. Brutes have no *Lamellæ* in their *Cerebellum*.

The various Processes are found in the inward Recesses of the *Cerebellum*.

The use of the
Processes of
the Cerebellum

In whose Surface the Processes seem to run some in Bevil, and others in a kind of parallel lines, and very many wheel up and down in Mæanders : which in Man and other Animals, resemble in use the *Anfractus* of the Brain, as so many repositories of Vessels, and their lines being various Fissures, or Trenches, passing between these numerous Processes, do give reception and security to the fruitful Branches of Arteries and Veins : Nay, the whole Processes are (as I conceive) upon a curious search, so many Systems of Vessels, branching themselves one within another in different divarications, after several forms and sizes, making the various models of these numerous Processes.

The diverse
ranks of Pro-
cesses are the
repositories of
Vessels.

The Antient and modern Anatomists have taken notice in some sort, of these Processes in the Surface of the *Cerebellum*, but have not made (that I can read) any inspection into their more inward Recesses, how they are seated in Depth in Ranks and Files one under another in admirable order ; and as far as I can apprehend, not any Anatomists have mentioned the lateral Provinces, only in general notices, of Circles and Episphæres, and have not pried into their more retired parts, how they are parted from each other, taking no cognizance of their inward arrangements of Processes, lodged below one another ; and (as I humbly conceive) are so many allodgments of Arteries, Veins, and nervous Filaments, making the bodies of these various Processes, appearing in several wonderful Schemes of different Figures and Magnitudes, proceeding from diverse postures and divarications of many, or few, greater, or less, longer, or shorter Vessels, accompanied with diverse minute Glands ; whereupon the *Cerebellum* as well as the Brain is encompassed with an upper and lower Vest : The First hath a Duplicature, plainly discernible every where near the margent of the *Cerebellum*, and is beset more or less all round the lower part of it, between the two Coats, with numerous little Glands, of a kind of orbicular Figure : The middle Protuberance also in the Origen of it, near the conjunction of it with the Base of the Brain, the *Pia Mater* is dressed with great variety of Glands, near the termination of the *Vermiform* Process.

The vessels of
the Cerebel-
lum are at-
tended with
many minute
Glands.

Also the *Dura Mater* about the skirts of the *Cerebellum*, hath many great Fibres, branching themselves into the inward Coat of the *Dura Mater*, and are divaricated as they go all along, and where it immediately covereth the Brain : And also between the two Coats of the *Dura Mater*, run an infinite number of minute Glands, affixed to the inside of both the Coats.

The Arteries
of the Cere-
bellum.

The *Cerebellum* is a Compagely made up of great number of Arteries, springing from the Vertebral and Veins from the Jugular ; These Vessels are lodged for their greater security in the Interstices of the *Lamellæ*, and being curiously branched through the *Pia Mater*, do often accost each other, being interwoven like Network, and at last do terminate into the Fourth *Sinus*.

The Veins of
the Cerebel-
lum.

This rare structure is not only composed of Arteries and Veins, but also of innumerable company of nervous Fibrils, as so many Sets placed in excellent order one by another, ending toward the *Cerebellum*, in which they are more eminent then in the Brain, and present us with a pleasant prospect, representing a fine Landscip, consisting of many Divarications, resembling a Tree, having several Ramifications, and Expansions of Frondage and Foliage, one sprouting out of another, the smaller out of the greater Fibres, which shoot out of Stalks, Stalks of Twiggs, Twiggs out of Boughs, Boughs out of Arms, and Arms out of Trunks.

The Divari-
cations of
Vessels resem-
ble a Tree.

The Trunks and bodies of Nerves belonging to the *Cerebellum*, are planted in the *Processus Annularis*, and *Medulla Spinalis*, these Trunks being composed of numerous Fibrils, divaricated through the substance of the *Cerebellum*, and do derive themselves from the *Cortex*, as so many Roots, out of which the innumerable Branches of nervous Filaments do spring.

The Nerve
of the *Cerebellum*.

Some Physicians are of an opinion, but upon what account I cannot conjecture, that those Processes are distended and contracted upon the elevation and depression of the *Cerebellum*, which hath no Ventricles, no *Plexus Chorooides*, but hath something resembling that Plex, made up of many vertebral Arteries, and jugular Veins, beset with diverse Glands, somewhat larger then those of the *Plexus Chorooides*, so that these Vessels, accompanied with numerous Glands, are rendred conspicuous, when the *Pia Mater* is stripped from the *Cerebellum*; and then on either side of the *Processus Vermiformis* may be discerned Branches creeping upward, and springing from the vertebral Artery, lodged under the lower Region of the *Medulla oblongata*, and the jugular Veins, transmitted from each lateral *Sinus*.

Some imagine the Processes are distended and contracted upon the elevation and depression of the *Cerebellum*.

The use of these Arteries and Veins, seated in the whole Compag, but principally in the hinder part of the *Cerebellum*, I conjecture to be this, That the more serous Blood, might be protruded through the Extremities of the Capillary Arteries, into the substance of the Glands, that the more watry Re-crements might be received into the Veins, and pass toward the Heart in circulation: But if there be so great a quantity of serous Liquor severed in the substance of the Glands, that it cannot be reconveyed into the small Extremities of the Jugulars; it exudeth, and (as I conceive) distilleth into the Fourth Ventricle, lying under the Processes of the *Cerebellum*, and *Caudex* of the *Medulla oblongata*, and is from thence conveyed through the *Infundibulum* into the jugular Veins, confining on the *Glandula pituitaria*.

The use of the Arteries and Veins of the *Cerebellum*.

The *Cerebellum*, though it be a distinct Body within it self, and separate from the Brain, enwrapped within the Coats of the *Dura* and *Pia mater*, proper to it, yet it holdeth an alliance, in similitude of Colour, Substance, Disposition, and Correspondence in its converse, both with the Brain, and *Medulla Spinalis*, to whose lower region it is fastned by the interposition of the *Pia Mater*, and entertaineth an intercourse with the *Medulla oblongata*, by the mediation of Two Processes, called by Dr. Willis, *Pedunculi*, each of which (saith he) is formed of Three Processes, *In utroque Pedunculo cerebrum sustentante, tres distincti Medullares Processus reperiuntur; horum Primus e protuberantiis orbicularibus emissus, obliq; ascendit, Secundus recte e cerebello descendens & per priorem decussatim transiens Medullam oblongatam circumdat; Tertius Processus e postica cerebelli regione descendens Medullæ oblongatæ inseritur, ejusq; truncum, velut Chorda ascititia, exauget.* And the *Pons Varolii* like a Bridge, passeth transversly over the Base of the *Medulla oblongata*, closely twining about it like a wreath, and encircling it like a ring, is therefore styled the annular Process, and (as I conceive) is framed after this manner, as soon as the middle Process of the *Cerebellum*, creeping down in a straight course, landeth at the sides of the *Medulla oblongata*, doth not seem to embody immediately with it, but enlarging it self into greater Dimensions, courteth the Surface of the *Medulla* with the embraces of many circular Fibres; whereupon the Processes of the *Cerebellum* issuing from either side, and brought down from the top of the *Medulla oblongata* toward its Base, do meet and embody themselves, constituting that circular Prominence, commonly called the *Processus Annularis*.

The *Cerebellum* is like the Brain in many Respects.

The Connection of the *Cerebellum*.

The *Pedunculus Cerebelli* is made up of Three Processes.

The *Pons Varolii*.

Thus

The use of the
various parts
of the Cere-
bellum.

Thus having given a rough draught of the several *Anfractus*, *Lamellæ*, or Circles, Processes, Plexes of Arteries and Veins, attended with many minute Glands; as also the numerous ranks of nervous Fibres, branched in excellent order through the Cortical and Medullary Compag of the *Cerebellum*. I conceive it not amiss to finish this rougher draught, in giving you Natures design in framing this great variety, by speaking the several uses of it: the chieft (being that of the *Cerebellum*, common to it and the Brain) consisting in the procreation of the Animal Spirits, made of the more active and spirituous parts of the Animal Liquor, the vital Liquor being impelled out of the ascendent Trunk of the *Aorta*, into the vertebral Arteries, is conveyed out of their terminations into the substance of the Glands, besetting the ambient parts of the *Cerebellum*, where the delicate part of the Blood is percolated from its more gross and fiery Particles, which are separated and returned by the Jugular Veins toward the Heart, while the more mild nutritious parts, impregnated with volatil Saline, and spirituous Particles, (commonly named the Animal Spirits) are transmitted into the roots of the Fibres implanted into the *Cortex*, and thence propagated by the same continued Fibres into the *Medulla* of the *Cerebellum*, by whose Processes it is conveyed into the Nerves, derived from the *Processus annularis*; and also by other Fibres communicated from the *Cerebellum* to the Nerves of the *Medulla Spinalis*, which is lodged within the Skull.

The Nerves of
the Cerebel-
lum assigned
by Dr. Willis
to be instru-
ments of in-
voluntary
Motion.

Learned Dr. *Willis* assigneth a peculiar Office, distinct from that of the Brain to the *Cerebellum*, to preside and influence with Animal Spirits, the Nerves consigned to all involuntary Motions, and natural Actions which he discourseth in the Fifteenth Chapter of his Book *De Cerebri Anatome*.

Quod nempe Cerebellum sit Spirituum Animalium, in quadam opera designatorum, peculiaris scaturigo & penus ab ipso cerebro distinctus. Et Cerebelli officium esse videtur Spiritus Animales novos suppeditare quibus actiones involuntariæ cujusmodi sunt Cordis pulsatio, respiratio, ratio ^{Abusus} alimenti concoctio, Chyli protrusio, & multæ aliæ quæ nobis insciis, aut invitis, constanti ritu fiunt, peraguntur. These involuntary Functions, he apprehended to be accomplished by Nerves, acted by Animal Spirits springing from the *Cerebellum*, by the intercession of the *Processus annularis*; *Nervi quidam* (saith he) *immediate a protuberantia annulari, aliq; in vicinia oriundi, qui functioni involuntariæ designati a Cerebello Spirituum Animalium influentias suscipiunt*; This Opinion is involved, (as I humbly conceive) with great difficulties, if not improbabilities, which I shall endeavour to discover, not out of any opposition to this Learned Author (whose memory I highly honour) but out of a love of Truth, by proving First that the *Cerebellum* hath not altogether a Province distinct from that of the Brain, in that the *Cerebellum* is an Author of voluntary motion as well as the Brain.

Diverse pair
of Nerves in
the Cerebel-
lum, may be
called the Or-
gans of volun-
tary Motion.

And Secondly, the Brain and not the *Cerebellum* is the greater fountain of involuntary actions. As to the First, it may be probably evinced, that the *Cerebellum* is the principle of voluntary Actions in some degree, as well as the Brain; For the Fifth, Sixth, and Seventh pair of Nerves (called by the former Anatomists, the Third, Fourth, and Fifth pair) do proceed from the sides and Base of the *Processus annularis*, a part appendant to the *Cerebellum*. The Fifth pair perforating the *Dura Mater*, is divided into two eminent Trunks, the First of which passing in a straight course, furnisheth the small Muscles of the Face with many considerable Fibres, which being variously contracted and relaxed, do cause those pathetick configurations, produced by the soft undulating motions of the Elevators, Adductors, Abductors of the Lips, and other

minute

minute Muscles of the Face. The motions of these Muscles invigorated by Animal Spirits, conveyed by Nerves springing from the *Processus annularis*, the offspring of the *Cerebellum*, do wholly comply with the dictates of the understanding, and commands of the Will, it being in our power, by the assistance of these pathetick Nerves, according to the impresson of our phantasy to change our Features into Smiles or Frowns, the pleasant or serene expressions of Love and Anger.

From the Fifth and Seventh pair of Nerves, are also imparted diverse Branches to the temporal Muscles, Lips, and Tongue, which being rendred Tense with Animal Spirits, emitted from the *Cerebellum*, can be diversly contracted at our pleasure, in free acts of Mastication and Speaking.

Thus having given an account of my first Hypothesis, that the *Cerebellum* hath not altogether a Province distinct from that of the Brain, in that the *Cerebellum* is an Author of voluntary Motion, though in a less degree than that of the Brain: Now it may not be unfit to speak somewhat of the Second Hypothesis, that the Brain, and not the *Cerebellum* alone is the principle of involuntary actions, which I shall endeavour to make good, by shewing how the Pulsation of the Heart, Respiration and the like, involuntary actions do proceed from the Brain. And First as to the pulsation of the Heart, it is merely an involuntary Motion, and the most noble and necessary of all, upon which our Life doth immediately depend; and therefore it is most wisely ordered by our Maker, That the Pulsation of the Heart should not be controuled by our Will, lest when we meet with severe accidents we should at once put a period to them and our Lives; and therefore the pulsation of the Heart is put out of our power, and derived from a set and constant influx of the Animal Spirits, conveyed for the most part, if not wholly from the Brain by the *Par vagum* into the Fibres, seated in the Right and Left Chambers of the Heart.

The involuntary motion of the Heart, proceedeth from Nerves of the Brain.

But this assertion meeteth with great opposition from Dr. Willis, who referreth all involuntary Motion, not to the Brain, but *Cerebellum* alone, as he most plainly affirmeth in his Fifteenth Chapter *De Cerebri Anatome*, *Imprimis, adverti nervorum paria quæ functionibus naturæ instinctu, aut passionum impetu, potius quam arbitrii nutu, obiri solitis, inserviunt ita immediate a Cerebello dependere, ut solummodo hinc in illarum origines Spirituum Animalium influxus derivari posse videatur.*

I conceive this Hypothesis is involved with great difficulties, because the motion of the Heart is not arbitrary, being celebrated by an instinct of Nature, and yet doth not depend upon the *Cerebellum*, as the only Origen, but upon the Brain as the greater source of the Animal Spirits, because the Systole in both chambers of the Heart, is produced principally by the Animal Spirits, communicated through a multiplicity of Fibres, springing from the *Par vagum*, and inserted into the greatest part of the Heart; wherefore if the Systole should be caused by the Animal Spirits, flowing from the *Cerebellum*, it should then be derived to the Heart by the Fifth, Sixth, or Seventh pair of Nerves, which take their Origen from the *Protuberantia annularis*, a Process of the *Cerebellum*, and not from the Eighth pair of Nerves; *vid.* The *Par vagum*, which ariseth out of the sides of the *Medulla oblongata*, a process of the Brain, as Dr. Willis confesseth in his Twenty third Chapter *De Cerebri Anatome*. *Octava nervorum conjugatio ab antiquis pro sexta habita, Par vagum appellatur; itaque infra nervos auditorios, octava nervorum conjugatio e lateribus Medullæ oblongatæ, radice ejus Fibris numerosis constante, exoritur.* And farther addeth, That a great Plex

is seated in the Trunk of the *Par vagum*, from which many Branches and Fibres are transmitted into the Heart; *E regione Primæ aut Secundæ Costæ, plexus alius insignis in trunco paris vagi consistit, quo plures furculi, aut Fibre versus Cor, & appendicem ejus demittuntur.*

Respiration is a natural action, derived from the Nerves of the *Medulla oblongata* and *Spinalis*.

And as to Respiration, I conceive it for the most part a natural action, seldom receiving a stop from the Will, which if done at any time, is quickly remitted, and is celebrated by the motion of the Lungs, acted by the contractions of the intercostal Muscles, and the Diaphragme. The intercostal Muscles are influenced by Animal Spirits, imparted by Nerves, not derived from the *Cerebellum*, but *Medulla Spinalis*, being a continuation of the *Medulla oblongata* of the Brain, communicating Nerves to the intercostal Muscles; and the motion of the Diaphragme is not produced by the influx of Animal Spirits, propagated from the *Cerebellum*, but conveyed from the brachial Nerves, taking their pedigree from the lower Vertebres, springing out of the *Medulla Spinalis*, the *Medulla cerebri elongata*. But it may be replied in favour of this great Author, That the *Par vagum* springing from the Brain, is not the great fountain of these involuntary actions of Pulsation of the Heart, and Respiration, because the intercostal Nerve hath a great share with the *Par vagum* in the production of these natural Motions: To which I take the freedom to speak this Reply, That the intercostal Nerve, (as some say) is a branch of the *Par vagum*; but the Author asserteth (as I conceive) more truly, that it deriveth its Origen from the Fifth and Sixth pair of Nerves, out of the *Processus annularis*, made up of a small middle Process of the *Pedunculus* of the *Cerebellum*; To which I argue with this proviso, That the Fifth pair proceeding from thence is principally dispensed into the Eyes, Nostrils, and Muscles of the Face, and a small branch descendeth only (which inosculateth below with the *Caudex*) to the *Par vagum*, to which also the Sixth pair imparteth another small Branch, so that the First Origen of the Intercostal Nerve arising out of the *Cerebellum*, is very small, and the Trunk of it inosculating with the *Par vagum*, consisteth principally of the intercostal Nerves, derived from the Spine; and the first rise of the intercostal Nerve, resembleth the head of a River, whose original Springs are very small, and the body of it swelleth, growing greater with the accession of new Rivulets below. The head Stream of the Animal Spirits distilling out of the *Cerebellum*, are conveyed by the smaller pipes of the Fifth and Sixth pair of Nerves, while the greater torrent of Animal Spirits doth hasten its course by the larger Channels of the intercostal Nerves, coming from the Spine (the long process of the Brain) to the *Caudex* of the *Par vagum*, and from thence into the greater Cisterns of the Heart, making frequent pulsations by the assistance of fleshy Fibres.

The Fountain of involuntary Motion is not derived solely from the *Cerebellum*, but chiefly from the Brain.

So that this Hypothesis remaineth firm, that the great Fountain of involuntary actions, is not derived from the *Cerebellum* alone, but chiefly from the Brain, and the *Medulla Spinalis*, its appendix, emitting great store of Animal Spirits by the *Par vagum*, consisting of Twelve Fibres; and the intercostal Nerves, principally proceeding from Fibres, arise out of the Spine, and are thence communicated to the Heart, intercostal Muscles, Diaphragme, Stomach, and Intestines; whence are produced the involuntary actions of Pulsation, Respiration, Concoction, and the protrusion of the Chyle, and the peristaltick motion of the Intestines.

C H A P. L.

The Cerebellum of a Man, and of other Animals.

HAVING set forth a more full History of the *Cerebellum* of Man, I will now shew you a more short prospect, as a Compendium of it, and of the *Cerebella* of other Animals, consisting of diverse Apartments, and various Processes, as so many fine Landscips, in which you may see the great difference of that more excellent *Cerebellum* of Man, from those of other Animals.

The *Cerebellum* of a Calf having this Situation, is composed of Three Provinces, one in the middle and Two lateral.

T. 50. F. 2.
The Cerebellum of a Calf.

The middle Province consisteth of Eight ranks of Processes †, (running cross-ways) which are endued with various kinds of irregular Figures.

† a a a a a a a a

The lateral Provinces † are furnished with numerous Processes, observing no order, nor determinate Figure, and begin in a kind of points, and end in larger dimensions, with rounded Heads.

† b b b b.

The beginning † as well as the rest of the *Medulla Spinalis*, is divided into Two equal parts.

† c c.

The *Cerebellum* of a Lamb (having this position) is made up of a middle, and Two lateral Provinces;

T. 50. F. 3.
The Cerebellum of a Lamb.

The middle Province consisteth of Four ranks of Provinces.

The Two uppermost rows go crossways † and are oblong and crooked.

† a a.

The Two lower ones † are much shorter, and seem to tend right downward, and have Figures much different from the former.

† b. b.

The lateral ranks † have many rows of Processes, endued with different irregular Figures,

† c c c c c c c c.

Part of the *Medulla Spinalis*, † divided into Two equal portions by a kind of Fissure near the *Cerebellum*, may be seen the *Glandula pinealis*, † and below this Gland may be discerned the Nativiform Processes † which are very large in this Animal.

† d d.

† e.

† f f.

The Testiform Processes † are appendant to the Nativiform, and seem to encircle their lower regions, as with a double Arch.

† g g.

The *Cerebellum* of a Pigg is composed of Three Provinces, a middle and Two lateral ones.

T. 50. F. 4.
The Cerebellum of a Pigg.

The middle apartment † begins and ends in smaller Dimensions, in a kind of obtuse Cones, and is made up of many Processes (running cross-ways) resembling a sort of Parallelograms in Figure.

† a a.

The lateral Provinces † consist on each side of Three or Four rows of Processes, dressed with different shapes.

† b b b b b b b b.

Not far from the *Cerebellum* may be seen the Nativiform Processes † endued with a kind of orbicular Figure.

† c c.

Above them may be discovered some other medullary Processes † of the Brain, of different Magnitudes and Figures.

† d d d d.

The

T. 50. F. 5.
The Cerebellum of a
Spaniel Bitch.
† a a.

The *Cerebellum* of a Bitch is framed of many Provinces, Two lateral ones, and one seated in the middle between them.

The middle Province † hath a more large Origen, and ends in more narrow dimensions, and is endued with many oblong Processes, going crossways and somewhat like Parallelograms in shape.

† b b b b b b b b.

The lateral Provinces consist of diverse ranks of Processes † which seem to be Five on one side, and Three on the other; near the Origen of the *Cerebellum*, may be discerned the Testiform Prominencies, encompassing the lower Region of the Processes.

† c c.

† d d.

† e.

In this Animal the Natiform Processes † do adjoyn to the terminations of the *Thalami nervorum opticom* † parted from each other by a Fissure †

T. 50. F. 6.
The Cerebellum of a Doe.
† a a.

The *Cerebellum* of a Doe is composed of One middle and Two or Three lateral Apartments.

The middle Province † is much larger then the other, and is made up of many oblong transverse Processes.

† b b b b b b b b.

The lateral Apartments † (are Three on each side) of which the largest encircles the middle Province.

CHAP.

C H A P. LI.

Of Nerves arising from the Brain within the Skull.

HAVING discoursed the various Processes and Coats encircling the Brain, The Nerves now offer themselves as so many Sprouts springing out of it, and (as I humbly conceive) are divers united Fibres, taking their Origins from the *Cortex*, and passing through the several Processes of the Brain, are conjoined in the *Medulla oblongata* about the Base of it, because Nerves being the continuation of Fibrous Particles (emitted out of the *Cortex*, passing through the substance of the whole Brain, into its lower region, perforating its Surface and Coats) expatiate into the Organs of Sense, and adjacent Muscular parts.

The Fibrils coming from the *Cortex*, are united in the *Medulla oblongata*.

So that every Nerve may be styled (as I apprehend) a System of many slender nervous Filaments, tied together by many thin Membranes, having in their inmost Recesses a kind of Medullary pulpy substance, a continuation of the *Medulla* of the Brain, propagated along the inmost parts of the Nerves, which is most conspicuous in the Nerves before they perforate the Skull, and most eminent in the Nerves of Fishes, which I have seen emitted out of their small Brains, not filling the Cavities of their Skulls, have thereupon longer Nerves within, especially the Olfactory, big within the Skull with a White Medullary substance, which is the same with that of the Brain, in colour and consistence.

The description of a Nerve.

It is the opinion of many Learned Anatomists, that the Nerves are compounded of a treble substance, of an outward and inward Coat, encompassing a third more tender pulpy substance; the exterior Coat, as they say, is derived from the *Dura Mater*, the interior from the *Pia*, encircling and securing the inmost *Medulla*, propagated from the Brain it self; To which I take the boldness to give this reply, That every Nerve is not only endued with a brace of Membranes, but if well considered, with more numerous thin Filaments, making up the body of the Nerves, which may be clearly demonstrated in Dissection, because every Nerve being a bundle of many Fibres immediately communicated to it from the *Medulla oblongata*, which is a composition of innumerable minute nervous Fibrils, either transmitted from the inmost Recesses to the confines of the *Medulla Spinalis*, or conjoined in particular Bodies, made up of many thin Coats, emitted from the upper and middle Regions of the Brain to the *Medulla oblongata*, and thence creeping through the Coats invest the Base of the Brain.

The treble substance of the Nerves.

And these fruitful Filaments, framing the greatest part of the Trunk of the Nerve, involve in their Center a soft tender substance, issuing out from, and continued to the Brain.

A soft tender substance is seated in the Center of the Nerves.

Having touched upon the Nerves arising out of the *Medulla oblongata* in a general notice, come we now to a more particular survey of them, which are in number Ten Pair, according to Dr. *Willis*, and other Learned Modern Anatomists.

† 48. n n.

The Mammil-
lary Processes.The perfora-
tion of the
Mammillary
Processes.The Mammil-
lary Processes
cannot be
truly called
Nerves.The Cavities
of the Mam-
millary Pro-
cesses.

The first pair of Nerves called Olfactory, having a double origination †, derive themselves from the *Crura Medullæ oblongatæ*, between the *Corpora striata*, and the *Thalami Nervorum Opticorum*, are Branches of Nerves coming from the *Medulla oblongata*, and making their progress near the *Processus Mammillares*, do pass through the *Os Crebriforme* into the Membrane of the Nostrils, and are the instruments of Smelling, taking their rise in a great part from the Fifth pair of Nerves, and are not truly the *Processus Mammillares*, so denominated from their Figure, being two white soft oblong Processes, terminating into a bulbous Form, in which they may seem somewhat to resemble Humane Paps, and have their Origin from the anterior Ventricles of the Brain, and not from the *Crura* of the *Medulla oblongata*, on which they hang loosely; and from thence being afterward transmitted toward the circumference of the Brain, are invested with the *Pia Meninx*, and being carried between the Brain and the *Os Sphenoidis* and *Frontis*, are covered at last with the *Dura Mater*, and are parted one from another by the intercession of the bony Process called *Crista galli*.

These Mammillary Processes are endued with Perforations terminating into the anterior Ventricles of the Brain, clearly demonstrated by the injection of Breath into them through a small Pipe, thence conveying Air into the Ventricles, which cause the Brain to be tumefied.

The Cavities of these Processes are so small in Man, that they are scarce discoverable, unless a Dissection be made presently after death, but in Sheep and Calves the round Cavities are much larger and very conspicuous, being often found turgid with Limpid Water; And in Birds the Cavities of the Mammillary Processes are extended to the Roots of their Bills.

These Mammillary Processes cannot be truly accounted Nerves, by reason they are not constituted as the Nerves are, of many Filaments, mutually conjoined by thin Membranes, but are only Processes of the Brain, made up of a *Cortex* and a Medullary substance, deriving themselves (not as Nerves) from the *Medulla oblongata*, but from the anterior Ventricle of the Brain, and are not at all fixed to the Base of it: Again, These Processes are not emitted through the *Dura Mater* and *Cranium*, into the Nostrils, the immediate Organs of Smelling.

And lastly, they have manifest Cavities, with which Nerves are not accommodated, they having only intermedial Spaces running between their Filaments; whereupon I humbly conceive, these Mammillary Processes having manifest Cavities, are not Nerves, but have Excretory Ducts, through which the serous Recrements of the Brain, destilling out of the numerous Glands (appendant to the *Plexus Choroeides*) into the anterior Chambers of the Brain, and are thence discharged through the Pores of the *Dura Mater*, and minute Cavities of the *Os Ethmoeides*, as a Colatory into the Red spongy Flesh of the Nostrils; and the purer part impregnated with Saline Particles of the Brain, is thence conveyed into the Mouth and mixed with the Masticated Aliment, as a preparatory *Menstruum*, the better to dissolve it, and to assist the Precipitation of the *Fæces* from the Alimentary Liquor in the Stomach.

A Learned

A Learned Anatomist conceiveth, that the mucous Matter destilling down the Cavities of the Nostrils is communicated by the Nerves transmitted from the Brain into the Glands seated in the Nose, and thence dropping, is evacuated by the Nostrils: But I deem it more probable that the greater part of the Serous Liquor, flowing out of the Choroidal Glands, into the anterior Ventricles of the Brain, is the great Fond of the mucous Matter passing from the Mammillary Processes, and thence streined through the Colatory Bone into the Channels of the Nostrils.

For the farther illustration and probation of this Hypothesis, I conceive it fit to add some Pathological instances: Mr. Maxwell, a Gentleman of the Court, often laboured under great Heaviness of the Head and Cephalick pains, and upon frequent taking of Sniff producing great Sneecings, had free evacuations of Serous Liquor (squeeced out of the Ventricles of the Brain) destilling through the *Os Ethmoides* into the Caverns of the Nostrils, which hath perfectly freed him, as he hath told me, from the dullness and pain of his Head.

A Maid formerly living in London, was highly tortured with a violent Head-ach, of which she was eased in the hight of her Paroxysmes, by great defluxions of a thin Yellow Serum out of her Nostrils; The next year the Cephalick Distemper fiercely returning upon her, and the evacuation of the Yellow Recrements being suppressed, she fell into violent Convulsions, accompanied with a great Stupor, determining into a strong Apoplexy, whereupon her Head being opened, a great inundation of this Yellow Serous Matter was discovered both outwardly in the *Anfractus*, and also in the inward Ventricles of the Brain.

The serous Liquor of the Brain cometh from the Nerves as some will have it. The Recrements of the Brain destill out of the Choroidal Glands.

CHAP.

C H A P. LII.

The Olfactory Nerves of other Animals.

The mammil-
lary Processes
of a Doe.

Under the Mammillary Processes of a Doe, are derived a pair of Olfactory Nerves, from the Base of the Brain, and take their progress on each side of the middle Cartilage, the *Intersepiment* parting the Caverns of the Nostrils, and end in broad Expansions, wrapped up in spiral wreaths, garnished with a number of small Fibres, the immediate instrument of Smelling.

The mammil-
lary Processes
of a Lamb,
Calf, &c.

And after the same manner the Nerves of Smelling in a Calf, Lamb, Pigg, and the like, have their first rise and termination, but the method of Fish and Birds is very different.

The Olfacto-
ry Nerves of
a Swan.
† 56. F. 2. ff.

The Olfactory Nerves of a Swan, seem to take their rise under the Second pair of Processes, and passing on the sides of the orbicular Prominencies, do afterward encircle the *Os spongiosum*, and terminate into many Filaments † (the Organ of Smelling) about the Perforation, placed not far from the middle of the Beak †.

† gg.

† bb.

The Perfora-
tions placed
about the
middle of the
Beak.

The Olfacto-
ry Nerves of
a Bustard.
† 57. F. 1. ffff.
F bb.

† iii.

The Olfactory Nerves in a Bustard, do spring out of the Two Prominencies adjoining to the anterior part of the *Medulla oblongata*, and climbing upward, creep out of the Brain, near the Origen of it, and do unite themselves for a little space, and then part again, encircling the outside of the *Os spongiosum*, where they make Two Arches † for an Inch, and then associate, and after a little space, are emitted out of them other small Branches, in form of minute Arches, and are afterward divided into various slender Fibrils †, besetting the Membranes, covering the Two oblong narrow perforations, seated on each side of the Beak, which are the main Organs of Smelling, being small Branches issuing out of the greater Trunks of Nerves, and are propagated to the termination of the Beak, where small nervous Fibrils are lodged, receiving the Appulses of Air, impregnated with odoriferous steams, conveyed through the minute Cavities of the Beak.

The Smelling
Nerves in a
Teal.

The Smelling Nerves in a Teal are seated a little beyond the Origen of the Optick Nerves, and do arise out of the Margent of the oval Prominencies, confining on the Origen of the *Medulla oblongata*, and make their progress in Two Trunks on the inside of the Eyes, and afterward go near the perforations of the Beaks, where they emit a Branch on each side, in form of a Cross, and afterward these Nerves pass forward in a straight course, till they approach the termination of the Beak, where they make flexures on each side, receptive of Air, sented with steams, through holes perforated through the Membrane, and Bones of the Beak.

The Smelling
Nerves of a
Goose.

The Smelling Nerves of a Goose do take their rise from the sides of the *Medulla oblongata*, and unite, and after a little space, part again, and are emitted out of the brain, a little beyond the Apices, or points of it, and afterward encompass the *Os spongiosum*, making a circumference in the form of Two Arches, conjoined in both their Extremities, a little beyond the *Os spongiosum*, and so continue for an inch and half, and afterward are inserted into Two oval protuberancies, out of which do sprout many small Fibrils, and end about the termination of the Beak, which is beset with many small Perforations

forations to receive Air, affected with odoriferous steams. And not only Two minute Perforations are seated in the termination of the Beak of a Goose but there are two larger also, which are oblong and narrow, lodged about the middle of it, about an Inch and half from the Eye; and on each side out of the middle of the Trunk of the Olfactory Nerves, arise Two fair Branches, they pass obliquely, ending with thin Expansions, lodged in these oblong narrow Perforations, made about the middle of the Bill, and are the Organs of Smelling.

The Nerves of Smelling in a Whiting, are Four in number, Two on each side, the upper derive themselves from the *Medulla oblongata*, and running on the skirts of the Brain, and the inside of the Eyes, after two Inches space, do conjoyn with Two White oval Protuberancies (which are of the same substance with the Brain,) and passing over these round Processes, do wheel in the manner of Arches, and decussate each other, terminating near the Perforations of the Nostrils.

† T. 66. F. 1.
b. b.
The Smelling
Nerves of a
Whiting.

The lower Smelling Nerves derive themselves from the Two Anterior Processes, and pass along the lower region of the Head, where they are united for an Inch, and then part, and address themselves to the lower Region of the round Protuberancy, seated without the anterior Processes of the Brain.

The Smelling Nerves in a Bale also are Four, Two on each side, the Two Superior take their rise near the termination of the *Medulla oblongata*, and go all along the outside of the Brain, and inside of the Eyes; and after some good distance, insert themselves into the upper part of the round Protuberancies, seated near the entrance of the Mouth. The Inferior Olfactory Nerves in this Fish, are propagated from the Anterior Processes of the Head, and go all along divided, and at last are inserted into the lower Region of the oval Processes, near the perforations of the Nostrils.

The Smelling
Nerves of a
Bale.

The Smelling Nerves of a young Cod, do sprout out of the sides of the *Medulla oblongata* near its rise, a little beyond the Opticks, whom they creep over and intersect, making their progress on each side near the inward Region of the Eyes, and at last arrive at the Perforations, made a little beyond the Eyes. And out of one Trunk in each side proceed Three Branches, the least and First is the above described Olfactory Nerve.

The Smelling
Nerves of a
Cod.

The Second Branch runneth in the middle of the other, being accompanied with a Branch on each side, and is fruitful in Ramulets, one passing near the upper part of the Mouth, and another taketh its course into the Muscles of the Face, and into the Palate, which are the Nerves of Taste; and the Third Branch lying opposite to that of Smelling, maketh its progress into the Muscles of the Neck; and after the same manner I conceive the Nerves are divaricated in most Fish.

In a Skate they arise out of the Apices of the *Pyriform*, being the First Processes, and make their progress obliquely crossways, toward the inward Orbits of the Eyes, and then perforate the Skull, and afterward arrive the Organs of Smelling, and thence creeping all along, make a round ridge on the Surfaces of them.

The rise of
the Olfactory
Nerves in a
Skate.
† T. 61. F. 1.
mm.

These Organs of Smelling are lodged without the Skull near the Mouth, in a cartilaginous Cavity, exactly fitted to them, they are of a Convex Figure above, and Concave below, and are a System of semicircular Filaments rarely disposed in regular ranks, observing an æquidistance one from another, sprouting on each side of the nervous *Caudex*, to which they are fastened,

running all the length of the Glands, do make diverse segments of a circle, whose Interstices are filled up with many Glandulous substances.

† T. 62. F. 1.
k k.
The Olfactory Nerves in a Thornback

The Organs of Smelling in a Thornback.
† 1111.

In a Thornback also the Olfactory Nerves † branch themselves out of the corners of the transverse Processes of the Brain, and thence make an overthwart progress toward the sides of the Skull, wherein Perforations being cut, through which these Nerves are conveyed to the Organ of Smelling, making long White Prominencies on the top of them.

The Organs of Smelling in this Fish, are covered with a blackish Membrane † through which may be discovered, as through a thin Vail, many whitish streaks, which are the glimmerings of many small Fibres, lying under the Membrane.

These Smelling Organs are seated below the Skull near the Mouth, in oblong Cavities, arched above, and on each side with small numerous Fibrils, ranked in a beautiful order, and propagated on each side from the Trunk of the Olfactory Nerves, passing over the middle of the Convex Surface of these Organs, whose Concave parts are for the most part closed below with Two membranous flaps, having on each side a straight passage, leading into this arched Cloister, the Organs of Smelling in a Skate, Thornback, Flaire, and the like great flat Fish.

CHAP.

CHAP. LIII.

Of the Optick Nerves of Man, and other Animals.

THE Second pair of Nerves called the Optick † is very large, and of a soft Compag, composed of many Filaments, enwrapping in their inmost Recesses a Medullary substance.

Diemerbroeck assigneth their Origen to the *Corpora striata*, seated in the Third Ventricle. This Author saith, that the outward Coat of these Optick Nerves is expanded about the streaky protuberancies, and is so blended with their substance, that their Fibres are united to each other; but I humbly conceive it more agreeable to Autopsy, to derive the rise of the Optick Nerves from the *Medulla oblongata*, which thence pass obliquely forward, and inward, near the *Corpora striata*. The Right Nerve, according to *Vesalius*, is carried toward the Left Eye, and the Left Nerve toward the Right Eye, and a little descending with a circumference, do meet about the *Infundibulum*, where they are united, not only by a decussation, but by an intimate embodying each others substance, as *Mercatus*, *Sennertus*, *Banbinus*, and other Learned Anatomists will have it: But it may seem more probable and consonant to Sense, that the Optick Nerves are only conjoyned by Membranes in a simple Contact, and not by any confusion of substance, as it is confirmed by the observations of many Learned Anatomists. *Vesalius*, *Aquapendens*, and *Valverde* have observed the Optick Nerves to be parted in their whole course, from the Brain to the Eye, *In adolescente nervos visorios congressu invicem non connasci, neq; sese contingere vidimus*, saith *Vesalius*, *Et ipsum de visu nunquam conquestum fuisse visu prastanti semper valuisse & familiares de visorum duplicatione nihil unquam intellexisse*.

The Optick Nerves after they are united, part again, and on each side, are transmitted through holes of the *Os Sphænoeides*, and inserted somewhat laterally into the Coats, near the center of the Eyes in Men, at last determining into an expanded soft Membrane, upon which visible objects make their appulses, immediately producing Sight.

In a Fish called a Base, the Optick Nerves intersect each other, and do not at all mingle with each others Substance and Filaments, but only the outward Coats do closely conjoyn near the Bone seated in the middle of the Brain, which on each side encloseth the greatest part of it; and the Optick Nerves also in a Gurnet do decussate each other, the Left Nerve passing to the Right Eye, and the Right Nerve to the Left Eye.

Eustachius found out the Optick Nerves all made up in folds, after the manner of fine Linnen Cloth. *In optico ait ille se comperuisse, scilicet eum complicatum esse, veluti tenuissimum matronarum linteum in rugas innumeras æquales, pari serie distributas, & tunicula eas ambiente coactum, qua incisa evolvi, & in amplam Membranam totam explicari posse*.

The Optick Nerves in a Bustard do spring out of Two oval Processes, conjoyned to the Base of the *Medulla oblongata*, and do closely unite themselves without any decussation; and then after a little space are divided, and passing obliquely, do insert into the inside of the Eyes.

The Optick Nerves.
† 48. P. P.

The rise of the Optick Nerves.

The Optick Nerves are not mutually embodied, as some phancy.

In a Base the Optick Nerves intersect each other.

The Optick Nerves of a Bustard.

The

The optick
Nerves of a
Goose, and
their rise.

The Optick Nerves also in a Goose do arise after the same manner, out of the Oval Protuberancies, appendant to the *Medulla oblongata*, and are conjoyned in a Node only, without any interfection, and then part taketh on each side an oblique progress to the Eyes.

The rise of
the Optick
Nerves of a
Teal.

In a Teal also the Optick Nerves are derived from the Oval Prominencies affixed to the *Medulla oblongata*, and being parted at first, do after a small space unite without any Decussation (as is frequently found in Fish) and are only conjoyned to each other so firmly, that they cannot be divided without laceration, and as soon as they are united, they presently after send out two large Trunks, which running transversely, are inserted into the inward region of the Eyes.

And having opened diverse other Brains of Birds, I have found the Optick Nerves to have the same Origin and Conjunction without any interfection, with those above described Fowl.

The Optick
Nerve of a
Turbut.

The Optick Nerves in a Turbut take their Origin from the *Medulla oblongata*, under the middle Processes, and do decussate each other, and then pass an Inch and half, and arrive the Eyes: The Nerve of the Left side making its progress to the Right, and the Nerve of the Right, in. o. the Left Eye.

† 7. 61. F. 1.
k. k.
The Optick
Nerves of a
Skate.

In a Skate the Optick † and Motory Nerves accompany each other, of which the Opticks are the largest, and First in order, being derived from each side of the *Medulla oblongata*, not far from the *Medulla Spinalis*, and do creep under the lateral Processes, to the sides of the Skull, which they perforate about an Inch from the lateral Processes.

The Optick
Nerves of a
Pike.

The Optick Nerves in a Pike, take their rise from the middle Processes, and do like a Turbut intersect each other, that of the Right passing to the Left, and the Left to the Right Eye.

The Optick
Nerves of a
Gurnet.

After the same manner the Optick Nerves in a Gurnet decussate each other, and do arise out of the *Medulla oblongata*, under the Anterior Process of the Brain.

The Optick
Nerves of a
Mullet.

The Optick Nerves of a Mullet do issue out of the Base of the *Medulla oblongata*, and not far from the Apex of it, and do plainly intersect each other.

The Optick
Nerves of a
Soal.

After the same manner the Optick Nerves of a Soal do cross each other, and do derive themselves from the *Medulla oblongata*, under the lower Region of the middle Processes, and are joyned together for some little space, and then part, intersecting each other.

The Optick
Nerves of a
Cod.

The Optick Nerves of a Cod do spring out of the *Medulla oblongata*, near its Origin, and do unite themselves without decussation, and then pass under the Olfactory Nerves, making their address to the Eyes.

C H A P. LIV.

Of the Motory and Pathetick Nerves of the Eyes.

THe Second pair of Nerves are called *Par Oculorum motorium*, which *Galen* styleth *σκληρότεροι καὶ μικρότεροι*, by reason they are harder and less in their Origen then the Optick Nerves.

The Motory
Nerves of the
Eyes.
T. 48. r r.

These Nerves borrow their Origen in the lower Region of the *Medulla oblongata* behind the *Indfundibulum*, and take their progress near the Optick, which they accompany in their passage through the Skull, inserting themselves into the Muscles, twining about the Globe of the Eye, which when they arrive, they separate into numerous Branches, sporting in various forms and motions of different antagonist Muscles.

The origen of
the Motory
Nerves.

The first Branch climbeth upward into the Elevator of the Eye-brow, lifting it upward, and the Curtain being undrawn, the Eyes being exposed to the brighter Rays of Light, are rendred capable of Sight.

The first Mo-
tory Branch
of the Eyes.

The Second Branch spreadeth it self into the Elevator of the Eye, moving it upward. The Third is carried toward the greater *Canthus* into the *Adductor* moving the Eye inward toward the Nose. The Fourth is transmitted with various Fibres, towards the lesser *Canthus* moving the Eye outward. The Fifth Branch passing downward, is inserted into the Depressor of the Eye moving it downward.

The second
Motory
Branch.

Next succeed the Pathetick, being the Fourth pair of Nerves †, which do not take their rise with the other from the upper Coast of the *Medulla oblongata*, near the round Processes, styled the *Nates* and *Testes*, whence they pass forward near the sides of the *Medulla oblongata*, and at last arrive the *Dura Mater*, under which they pass a little way, and then are carried through the Skull in company of other Nerves, appertaining to the Eyes, and have peculiar Branches inserted into the *Musculi Trochleares*, and are called by Doctor *Willis*, the Pathetick Nerves, because he conceived them to be instruments of various motions and affections of the Eyes, caused in passions of Fear, Shame, Anger, and Sorrow. These Nerves only affect the Eyes pathetically, when as other Muscles of the Face are variously featured with Nerves issuing from the Fifth, Sixth, and Seventh pair of Nerves: according to Dr. *Willis's* Conjecture, the *Processus Mammillares* are the Olfactory Nerves; and the first pair, which I humbly conceive, are only Medullary Processes of the Brain, and no way Nerves, whereupon the Pathetick Nerves are not only those of the Eyes, but also the Fourth, Fifth, and Sixth pair of Nerves are the most considerable Pathetick, whose various motions being very gentle, cause the divers Features and Configurations of the Face.

The rise of the
Pathetick
Nerves of the
Eyes.
† T. 48. s s.

The Fifth pair of Nerves, called by the Antients the Third, are seated below the other pair of Nerves, and have their Origen form the Sides of the Annular Process, being a large broad Trunk, made up of many hard and softer Fibres, ordained to exercise the Functions of Sense and Motion in many distant parts, whence their consent and sympathy is maintained in the Organs of Sight and Smelling, by the communion of Nerves: And the *Præcordia* being affected according to the several apprehensions of the Brain,

† T. 48. T. T.
The Seat and
Origen of the
Fifth pair of
Nerves.

their passions are communicated accordingly to the different parts of the Countenance, giving it various Air and Features.

The largeness
of the Fifth
pair of
Nerves.
The first
Branch.

This pair is the most large next to the *Par Vagum*, and is very fruitful in Ramifications; The first Branch sprouting directly downward, is carried through the Skull in a peculiar Perforation, and descendeth toward the lower Mandible, bestowing divers Fibres upon the Temporal Muscles, and those of the Cheeks and Face, as also the Lips, Gums, Teeth, Fauces, Tonsils, Palate and Tongue, do not only assist the act of Masticating Aliment, but the sensation of Taste, Smell, Touching, and the various Configurations of the Mouth and Aspect in Frowns and Smiles.

The second
Branch of the
Fifth pair of
Nerves.

The next Branch of this pair is transmitted straight under the *Dura Mater*, near the side of the *Sella Equina*, and afterward communicateth divers Fibrils to the *Rete Mirabile*, and then associateth with the Sixth.

The second
Branch of the
Fifth pair of
Nerves and
their pro-
gress.

The Second Branch of the Fifth pair, relating to the Eyes, is divaricated into many minute Ramulets, some of them climbing over the Muscles of the Eyes, and others into their Glands, are inserted into the Eye-lids; and others creeping under the Tendons of the Muscles, do insinuate into the *Cornea* and *Uvea*; So that these Fibres branched into the Glands and Lids of the Eyes, are subservient to the pathetick, doleful motions, and sadness, and by drawing the *Præcordia* into consent, do cause inordinate motions of the Heart, by reason this Nerve is both dispensed into the Eyes, and also into the Intercoastal Nerves, propagated into the Heart, and taketh its first rise from the same Nerve; whereupon the Eyes and Heart at once sympathize in condoling the same sad events.

The Second Branch of the third Subdivision of the Fifth pair of Nerves, being transmitted toward the Orbit of the Eye is parted into two Branches, the lower stooping down, spreadeth it self into more and smaller Ramulets inserted into the Palate and Fauces, and the upper Branch being carried in a peculiar Perforation of the upper Mandible, is dispensed into the Muscles and Surface of the Face, these Nerves being accompanied with Veins and Arteries, about which divers Tendrils of this Nerve being twined, do in their irregular motions compress the Veins and intercept the course of Blood in the Skin of the Face, the cause, as I conceive, of blushing from the apprehension of Shame, the immediate consequent and shadow of Guilt: And the Fibres of these Nerves being implanted into the fleshy parts of the Lips, and others also of the same Nerve being imparted to the Intercoastal Nerves, are propagated down to the Heart, upon which account amorous Kisses courting the Lips, do readily convey their impressions to the nobler parts.

The sixth pair
of Nerves.
† T. 48. vv.

The Sixth pair of Nerves †, according to Dr. *Willis*, do arise out of the lower Region of the Annular Process, and passing under the *Dura Mater*, are carried through the Skull in company with the Motory and Pathetick Nerves, and hath a proper Trunk, propagated to the Orbit of the Eye, and is Inosculated near the *Sella equina* with the Second Branch of the Fifth pair of Nerves, from thence emitting divers Branches, which being reflected, do unite with the Branches of the Fifth pair, and do give the first rise of the Intercoastal Nerve. Another Branch of this Nerve making its progress forward near the Orbit of the Eye, is divided into many Fibres inserted into the Abductor, seated in the smaller Angle of the Eye, and hath another Branch in Brutes divaricated into many Fibres, dispensed into the Seventh Muscle.

The

The Seventh pair †, called the auditory Nerves, consist of a double, a soft, and a hard substance. Dr. Willis calleth them a double pair in reference to different Originations, though near one another; The first Process (which is most deservedly called the Auditory, springeth out of the inferior side of the Annular Process in Man, but in Brutes out of the middle of it; This softer Nerve arising below out of the *Pons Varolii*, doth somewhat ascend before it is emitted the *Caudex* of the *Medulla oblongata*, and afterward is transmitted by a proper Foramen into the inmost Cavity of the Ear, and is fruitful in many minute Fibres, which are inserted into a thin Membrane investing the *Coclea*, upon which the Sounds make their Appulses, and nervous Fibrils implanted into the Membrane of the Ear are first affected, and they having a continuation with the Auditory Nerves, carry them to the common Sensory.

The seventh pair of Nerves.
† T. 48. W. W.

But the hard Processes of the Seventh pair, or rather a different Nerve, is ministerial to the Motion rather than Sense, and hath a proper Channel in the *Os Petrosum*, through which it passeth near the Auditory passage, and falling into society with the *Par Vagum*, is immediately after propagated into a double Branch, the first tending downward, is inserted into the Tongue, and the *Os Hioides*; The other encompassing the Auditory passage, and being thence transmitted downward, is branched into three Ramulets, of which the first imparteth many Fibres into the Face, Nostrils, Lips and Mouth; The second to the Eye-lids, Ears, and Voice, and by the entercourse of these Nerves hold a correspondence with each, and when some unusual sound is received into the Ear, the Eye-lids are lifted up, and by reason of many small Branches transmitted also from the same Nerves, into the Mouth, Lips, and Tongue, whereupon the Sound is communicated to the Organs of Speech, and the Voice being æmulous of it, answereth like an Eccho.

C H A P.

C H A P. LV.

Of the Eighth, Ninth, and Tenth pair of Nerves, and the Accessory Nerve.

† T. 48. x x.

THE *Par Vagum* †, called by the Antients the Sixth pair of Nerves, by the Modern Anatomists, the Eighth ariseth a little below the Auditory Nerves out of the sides of the *Medulla oblongata*.

This Nerve is a system of many Nerves, or at least of numerous Filaments, to which a Nerve taking (its origen from the *Spinalis Medulla* contained within the Skull) is associated, and being both invested with one common Coat propagated from the *Dura Mater*, are carried through one perforation of the Skull, as if they were embodied in one common Trunk, but that Spinal Nerve and many other Fibres remain distinct, and afterward parting from one another, have difference of sizes, and are transmitted into several distant parts; because the Spinal Nerve, after it hath crept through the Skull, quitteth the company of the other Fibres, and is implanted into the Muscles of the Neck and *Scapula*: And two other Fibres of the *Par Vagum*, parting with the rest, are transmitted into the Muscles of the Gullet and Neck, and the other Fibres going in company with each other, afterward get a Fraternity with the Intercostal Trunk in Brutes, and with a Branch only in Men, and emitteth another eminent one into the *Larynx*, which expatiateth into the Muscles of the Gullet and *Larynx*, and passing under the Buckler Cartilage, goeth to the Apex of the recurrent Nerve, to which it is united, and about this place, where the *Par Vagum* is joyned to the Intercostal Nerve; the *Caudex* of the *Par Vagum* is amplified in an oblong Tumor, called the *Plexus ganglioformis*, now and then single and sometimes double.

The Ganglioform Plex of the *Par Vagum*.

This and other tumefied Plexes may be considered as Knots in Canes, or Trunks of Trees, out of which Boughs do spring, and are framed where either a Branch of a Nerve is emitted out or received into the Trunk, and the Trunk is augmented, when many Branches do issue out or are admitted into the *Caudex* of the Nerves.

The use of the Knots in the body of the Nerves.

These Knots in the body of the Nerve, have this institution, as I conceive, to preserve the Animal Spirits and nervous Liquor entire from Confusion, that they may be kept separate one from another, when they are designed to several offices in distinct and remote parts.

Another Plex of the *Par Vagum* united with the Intercostal Nerves.

Not far from the *Plexus ganglioformis*, may be seen another with the Intercostal Nerve, being made of it, with a Branch of the last Nerve seated within the Skull; These Plexes may be discovered by raising the *Musculi mastoidei*, and by opening the neighbouring Muscles of the Neck, you may detect the Carotide Arteries, and by tracing their ascent, the Plexes of the *Par Vagum* may be discerned, near the insertion of the lower Mandible.

A little

A little below the Plex of the *Par Vagum* from its Trunk are transmitted straight downward (near the ascendent Trunk of the Carotide Artery) divers small Fibres, which sometimes twine about the Artery, and sometimes are inserted into its Coats. And in the lower Region of the Neck, the Trunk of this Nerve creepeth down without any eminent ramification till it arrive over against the first or second Rib, where it formeth another Plex, out of which numerous Fibres are dispensed toward the Body, Auricles, and *Pericardium* of the Heart, making different divarications in both sides of it.

Nervous Fibres twining about the Carotide Artery, are sometimes inserted into its Coat.

A Plex of the *Par Vagum* out of which many Fibres are propagated to the Heart. The rise and progress of the recurrent Nerve.

Where the *Par Vagum* entereth into the Cavity of the *Thorax*, it riseth higher in the right side, and is reflected like a Pulley upon the Axillary Artery. But the recurrent Nerve in the left side, taking its rise lower, is reflected about the Trunk of the *Aorta*; So that these Nerves from their progress up and down, are styled Recurrent, first from their descending near the Arteries into the Cavity of the *Thorax*, and afterward ascending, have recourse into the Muscles of the *Larynx*, into whose Origins they are implanted with fruitful Ramulets.

The *Par Vagum* in its passage up and down, imparteth divers Fibres to the *Aspera Arteria*. And more especially a little below the left Recurrent Nerve an eminent Branch springeth out of the Trunk of the *Par Vagum*, dispensing divers Branches toward the hinder region, as also the anterior region of the Base of the Heart enameing the whole surface of it with Fibres, worked to a wonder in great divarications.

The *Par Vagum* dispenseth many Fibres into the Base, Cone, and anterior and posterior region of the Heart.

And there are two Plexes, from which divers Branches are dispensed into the Heart: The upper and larger is seated between the *Aorta* and the Pulmonary Artery, and the Nerves composing this Plex, are eminent Branches derived from the Trunk of the *Par Vagum* and the Intercostal Nerves; Out of this Plex two or three Nerves creeping under the *Aorta*, do pass into the left Chamber of the Heart; And another Branch encompasseth the Pulmonary Artery as with a little handle, and out of its anterior part a Branch descending about the right Trunk of the *Par Vagum*, and another out of the Nerve (destined to the hinder region of the Base of the Heart) do at last all meet together and constitute the lesser Plex out of which divers Fibres are transmitted into the forepart of the right Chamber of the Heart.

The Branch of the *Par Vagum*, encircleth the Pulmonary Artery.

The lesser Cardiac Plex of the *Par Vagum*.

Out of the same Trunk of the *Par vagum* (from whence the Cardiac Nerves are derived) are propagated many Branches, implanted into the Stomach, whence ariseth the great sympathy between the Heart and Stomach, (as Learned Doctor *Willis* hath well observed) whereupon in violent Vomitings, the Stomach being highly convulsed, the Patient falleth into *Lypothymies*, *Syncopes*: The Nerves coming from the Trunk, are chiefly distributed into the upper part, and Mouth of the Stomach (the chief seat of Hunger) as also into the Coats of the Gullet, and into the *Bronchia*, and their appendant Vesicles of Air; whereupon a Cough of the Lungs often causeth Vomiting, and again, Vomiting often produceth a Cough, as the Lungs, Gullet and Stomach are endued with many Nerves, propagated from the same Trunk of the *Par Vagum*.

The Branches of the *Par Vagum* implanted into the Stomach. The cause of the Sympathy between the Heart, *Larynx*, and Stomach.

And after many Branches are communicated to the Heart, Lungs, &c. the *Par Vagum* from a Trunk seated below the Lungs, doth emit an exterior and interior Branch, which being conjoyned, afterward do constitute

The rise of the upper and lower Stomach Branch.

stitute the upper and lower Branches of Stomacick Nerves, which do furnish all parts of the Stomach with numerous Fibres.

The Interco-
stal Nerve and
its union with
the *Par Va-*
gum.

The Ganglio-
form Plex.

The Intercostal Nerve is made of many Fibres, coming from the Brain and *Medulla Spinalis*, which do associate with the *Par Vagum*.

The Intercostal Nerve, not far after its egress out of the Brain, doth make the Glangloiform Plex near that of the *Par Vagum*, into which some nervous Processes are inserted, which are derived from the first Verteber; from this Plex one Branch is implanted into the Sphincter of the Gullet, and another into the Ganglioform Plex of the *Par Vagum*.

The Cervical
Plex, from
which are de-
rived Fibres
into the Dia-
phragm, Re-
current
Nerve, Wind-
pipe, Gullet,
Cardiack
Plex, &c.

The Intercostal Nerve descending near the Vertebres, maketh another greater Plex (seated in the middle of the Neck) into which a large Nerve, coming from a near Vertebral pair, is inserted; From this Branch are Fibres derived, which confederate with the Nerves of the Diaphragm and recurrent Nerves; and toward the *Aspera Arteria*, many Fibres of this Plex are inserted into the Coats of the Windpipe and Gullet, and into the Cardiack Plex, as also into the Axillary Artery; and about the Roots of the first and second Rib there are four Branches coming from the Vertebral Nerves, which do constitute an eminent Plex, called the Intercostal.

The Interco-
stal Nerve
furnisheth all
the parts of
the lowest
Apartment
with nervous
Branches.

The Intercostal pair, passing out of the second into the third Apartment, over against the bottom of the Stomach doth send out on each side a Branch, the upper maketh the Mesenterick Plexes, being seven in number (as Dr. *Willis* will have it) wherein divers Fibrils every way display themselves, like so many Rays, and are implanted into the Stomach, Spleen, Liver, *Vesicula fellea*, *Ductus Cholidochus*, *Pylorus*, Kidneys, *Capsula Atrabilaria*, Intestines, and into the Testicles in Men, and Ovaries and Uterus in Women, as also into the Ureters, Bladder, Seminal Vesicles, Prostrats, *Penis*, and into all parts of the middle and lowest Venter.

The Spinal
Nerve is
assitant to the
Par Vagum.

Having given a short History of the *Par Vagum*, Intercostal Nerve, and their progress, through various parts, it may not be improper to give some account of the Spinal Nerve as contributing to the operation of the *Par Vagum*, which having its Origen composed of many Fibres, with which another eminent Nerve (coming out of the *Medulla Spinalis*) espouseth an union, and passeth out of the same hole of the Skull with the *Par Vagum*, with which it Inosculates, and maketh one Trunk, as having one joynt office.

The Spinal
Nerve confe-
derates with
the *Par Va-*
gum.

This Spinal Nerve after it hath associated some time with the *Par Vagum*, it quitteth its converse, and is reflected outward, and imparteth divers Fibres to the Muscles of the Neck, and bestows many Fibres to the Tenth pair of Nerves, with which it is in conjunction both in Trunk and Office, and is not only found in Man, but in Beasts, Birds, and Fish.

As to the use Nature hath consigned this accessory Nerve, it is reasonable it should take its Origen from the Spinal Marrow, because it is subservient to the Muscles of the Neck and Arms, which are nearer to the *Spinalis Medulla* then to the *Medulla oblongata*; or rather by reason the Hands and Arms are more highly seated in Man, (then the Limbs in Brutes) and have a greater approximation to the Heart and Brain, and therefore do more conspire with the affections of these noble parts, whereupon the accessory Nerve (taking its rise from the *Medulla Spinalis*) enters into association with the *Par Vagum*, and highly promotes its operation in point of the Muscular motion of the Heart and other Muscles of the Neck.

The

The Ninth pair of Nerves, where they take their rise, may be called Systems, made up of many Fibres, which being conjoyned, do constitute Trunks, out of which are dispensed many minute Fibres, into various Muscles, and Coats encircling them, giving the Carnous Fibres vigor to make various motions (in order to the reception of Aliment) and to make several appulses upon the Palate, Teeth, Lips, as by so many stops, modelling the expired Air for the articulations of Letters and Words, the various expresses of our mind.

And for the better accomplishing of many different motions, it immits a branch downward, into the Tongue, besetting it with various Fibrils. This branch meets with another coming from the Tenth pair of Nerves, and associates with it, and is afterward implanted into the *Musculus Sternothyroideus*; And another branch of the Ninth pair, is communicated to the Muscles of the *Os Hioides*, which are furnished from thence with a number of smaller Fibres.

The Tenth pair, though they may seem to have many Fibres arising within the Skull, yet for the most part have their Fibres sprouting out of the first and second Vertebres of the Spine; and presently after their egress, do send two Nerves into the Intercoastal Branch; but the greatest part of their Trunks doth impart many Nerves to the Muscles of the *Larynx*, and Neck, which are beset with fruitful Ramulets of Nerves, propagated from the Tenth pair of Nerves.

The Ninth pair of Nerves.

The Nerves of the Tongue coming from the Ninth pair.

The association of a Branch of the Ninth pair with another of the Tenth. A branch of the Ninth pair is distributed into a Muscle of the *Larynx*. Another branch is dispensed into the Muscles of the *Os Hioides*. The Tenth pair of Nerves hath many Fibres from the Spine.

CHAP.

C H A P. LVI.

Of the manner of Sensation.

HAVING shewn you a rough draught of the Membranes and Processes of the Brain, I do now take the boldness to give you an account of the Offices of them, and how and where the Animal Liquor taketh its rise, and how it is propagated by continued Fibrils, through the whole Compag of the Brain into the Nerves, and how Sensation is celebrated in the outward and inward Senses.

The most admirable Globe of the Brain is enwrapped within the *Dura* and *Pia Menynx*, as with upper and lower Robes, which are made up of innumerable company of minute nervous Fibres, so closely wrought, that they seem to make one entire substance, interwoven with variety of small Tubes of Arteries and Veins, branched and twined about the Membranes, like Arbors overshadowing this bright Orb, and importing and exporting Purple Liquor into and from the Coats and Processes of the Brain, to impart Life and Heat to them.

These fine Vails encircling the Brain, are beset both above and below with numerous small Glands, which are collections of Vessels, rarely arched and lodged within each other, which are so many Colatories of the Blood, and are so interspersed with numerous Plexes of Vessels, that they are scarce discernible, except in Hydropick Brains, where they being rendred big with serous Liquor, are more easily discovered; the Glands being so many rare Compages of Vessels, in whose Interstices the pure part of the *Succus Nervosus* being severed from the more gross, distilleth into the extremities of the nervous Fibrils, lodged in the ambient parts of the Brain, and is thence carried through the several Processes, curiously seated within each other, and are framed chiefly of nervous Filaments, by which they hold an entercourse one with another, conveying Animal Liquor from one Process to another, through the whole Compag of the Brain.

These nervous Fibrils interspersed with capillary Arteries and Veins, are interlined with a thin soft *Parenchyma*, and are originally formed out of the more viscid Particles of the Seminal Liquor, concentered into Filaments, to whose Interstices some genital Matter being somewhat indurated, doth stick, making the *Parenchyma*, adherent to the outside of the nervous Fibrils, whose Roots seated near the Surface of the Brain, give the first reception to the Animal Liquor, extracted out of the more delicate part of the *Succus nutritius*, which was first impregnated with the volatil parts of Air, associated with Blood in the substance of the Lungs, which is thence carried into the Heart, and afterward through the common, and the ascendent Trunk of the *Aorta*, and Carotide Arteries (climbing up the sides of the *Glans pituitaria*, making many Plexes) before it entrench into the Brain, to render its motion more gentle to prevent all inundation; whereupon the Blood is carried up softly into the Membranes and Surface of the Brain, encircled with cortical Glands, as so many small Systems of various vessels, running one within another, in less and less Arches, encompassing each other, till they make an oval Figure, for the most part, if not wholly composed of nervous Fibrils, Veins and Arteries, whose extre-

mities

mities dispense Blood, confederated with *Succus nutritius* into the spaces of these Vessels, where it receiveth an alteration by Interstine Motion, as consisting of Saline Particles, made up of different Figures and Magnitudes; and having disproportioned Sides and unequal Angles, cannot so nearly close, but they must of necessity make little Interstices, in which the disagreeing Particles do play up and down, and continue their motion; as they are acted with volatil and more gross parts, the volatil still endeavouring to quit their station, were they not not confined within the walls of the more gross parts; and thereupon gain the advantage of refining themselves, by the agile Converse of the more spirituous Particles: So that the Blood, accompanied with *Succus nutritius*, being composed of spirituous and grosser parts, is transmitted into the substance of the Cortical Glands; and as they are made up of different Natures, have also various Figures and Magnitudes, speaking disagreeing sides, and unequal Angles, which cannot so nearly approach each other, but they must necessarily leave such spaces as are, fitted for the reception of Air, inspired with æthereal Particles, which are first impelled through the Nostrils, into the chambers of the Brain, and thence transmitted through the passages of the *Corpus callosum*, into the substance of the Cortical Glands, where the Purple Liquor, embodying with the nitrous parts of Air, and the saline Particles of the Brain, is put into an intestine Motion, by rendring its gross parts more volatil and spirituous. And furthermore, the elastick quality of Air doth open, and loose the Compage of the Blood; whereupon the more delicate Particles of the *Succus nutritius* are separated from the Blood in the substance of the Cortical Glands, and agreeing in Figure and Magnitude, with the Orifices of the nervous Fibrils, seated in the Glands, is thereupon transmitted into the Interstices of them (and the Red parts of the Blood, being proportioned to the shape and size of the venal extremities) are conveyed into them.

And the Animal Liquor being received into the Origins of the Fibrils, its progress is more and more advanced by the motion of the *Dura* and *Pia Meninx*, and the surface of the Brain, caused by the vibration of the Arteries, compressing the outward parts of the Brain, and protruding the nervous Liquor, which receiveth more and more recruits by a constant generation in the substance of the *Cortex*, (wherein one part of the Animal Juyce still presseth another forward, making its motion good) through whole Filaments it is successively conveyed into the *Fornix*, and from thence into the Fibres of the *Medulla oblongata*, and Trunks of Nerves issuing out of it, to export nervous Liquor to impart Sense, Motion, and the more excellent kind of nourishment to all parts; So that this most delicate Liquor of the whole Body, is made up of most thin volatil Particles, as acted with Animal Spirits, and so insinuateth it self between the Filaments of the nervous Fibres, softly swelleth their tender Particles, producing a gentle Tension, partly caused by the fine elastick parts of Air, so well embodied with the Animal Liquor, that it may be well judged (as I conceive, a constituent part of it.) Whereupon the Interstices of the tender Fibrils being plumped up, and somewhat stiffened, (as inspired with Particles of Air, consociated with Animal Liquor) are rendred more or less Tense, and so are receptive of greater or less Contractions, as they are acted more remissly or briskly from within, by the dictates of the Will or Appetite, or from without by the milder or strong Appulses made upon the outward Organs by sensible objects.

And these tender Fibrils are capable of different postures in the Brain, as they receive any the least change in their natural situation, and so in some

fort they may be termed to be extended and relaxed, as the Interstices of nervous Filaments, are receptive of more or less nervous Liquor, impregnated with refined Spirits, and so become contracted or remitted in some greater or less degree; Whereupon I humbly conceive, that the nervous Tendrils, are never so absolutely relaxed, but they partake of some kind of Tension or other, unless where the vital flame is totally extinct, else it is impossible to apprehend, but some influx of the Animal Spirits may be communicated to these nervous Fibrils.

The most common relaxation of them is made in sleep, and then the outward sensible Organs cease from their Operations: And the Muscles are despoiled in a great degree of their tonick Motion, consisting in a moderate Contraction, equally imparted to the Antagonist Muscles, which countermand each other, in giving a balance to their unequal and utmost contraction; so that this tonick motion when we are awake, is a moderate tension of all the Fibrils, arising from a more free influence of the Animal Liquor, flowing into the Interstices of their Filaments, putting the Brain and outward Organs, into a disposition to exert their Functions, which much cease in our repose, wherein the nervous Fibrils grow flaccide, and unable to celebrate the Sensitive and locomotive Operations, produced from the free access of Animal Liquor, denied to the Origins of the nervous Fibrils, seated in the Cortex of the Brain, to which, when we are awake, is communicated a more liberal Influx of nervous Juyce, running between the numerous Filaments softly, and after a manner puffing them up with airy elastick Particles, making somewhat of stiffness in the tender frames of the nervous Fibrils, giving them a promptitude to be tuned for the admirable operation of Sensation, which is made up of great variety of sensitive powers, as in some sort the principal Agents, attended with a great *Apparatus* of diverse Sensories and Objects; as to the percipient Power, it is a branch of the sensitive Soul, residing in the more inward Recesses of the Brain, styled the Common Sense, apprehending and judging the various motions made by sensible Objects upon the outward Organs, and thence conveyed to the inward Sensory.

Thus having given you a general notion of Sensation, I shall now present you with a more particular account of it and its Motion, by laying down the method, how it is instructed and directed by the superior Faculties, and the manner of Sensitive perception, how it is made by the different Appulses of sensible Objects, upon the outward Organs and thence derived by Nerves and Fibrils to the common Sense.

The understanding or counselling Power of the Soul, propounding an object under the notion of good or evil, the Will refuseth one as destructive, and electeth the other as perfective, and thereupon giveth its Commands by its emissaries, the Animal Spirits, the more refined Particles of the Animal Liquor, to invigorate, first the Fibrils of the Brain, and then the Nerves issuing out of them, and afterward dispensed into the Muscles, to give by their various Contractions the different motions of the Limbs, to prosecute that Good, First propounded by the dictates of the understanding, and after ordered by the imperate acts of the Will, thereby giving her Commands to the inferior Powers, the irascible, concupiscible, and locomotive Faculties. And this method of operation of the rational Powers, upon the sensitive Appetite, is moved from within, outward, by First impregnating with spirituous Liquor the Fibrils of the Brain, and then the Trunks of Nerves are embodied with Fibrils sprouting out of the Brain, and after propagated into the Muscles of the Body: But the method of Sensation, derived from the outward Senses

ses hath a retrograde motion; here the Scene is far different, and the Machines play first from without, and are afterward carried to the inward Recesses of the Brain; First the motion is celebrated in the outward Senses, wherein their Objects, making their first attempts and impressions upon the Fibres of their Sensories, are thence conveyed to the common Sensory by continued Nerves and Fibres, at last inserted into the *Corpus callosum*: as I conceive, the seat of the common sense, which judgeth the strokes of sensible Objects, given upon the Membranes of outward Organs.

Whereupon the Sense abstractly conceived, either under the notion of outward, or inward Sense, formeth but an imperfect conception of Sensation, the one assisting, and the other compleating the other; so that Sense concretely considered, as involving the outward and inward Sense, must go hand in hand to accomplish Sensation, as they both hold a near intercourse in their Sensories, as being united one to the other by the mediation of Fibrils and Nerves. The outward Sensory gives the first reception to the Appulses of sensible Objects, (made upon their Fibres,) which are thence transmitted by the continuation of Nerves and Fibrils to the inward Sensory, where the common Sense determineth the perception, recommended to it from the outward Organs. And this Hypothesis I shall endeavour briefly to illustrate in several instances, drawn from the manner of Perception (produced by the Organs of different outward Senses) consisting in the motion of the Objects, and the contact of the Sensories of Smelling, Seeing, Tasting and Hearing. As to the sense of Smelling, the steams exhaled from odoriferous Bodies, being associated with Air, are carried up into the Caverns of the Nostrils, where these thin *effluvia*, being Systemes of many minute Bodies (received into the Sensory of Smelling) are configured to the Pores of the inward Membrane of the Nostrils, composed of many Fibres derived from the Fifth pair of Nerves, which are affected with soft and pleasant Appulses, when the minute steamy Bodies agree in the size of their Angles, with that of the Pores of the nervous Fibres; but when they are of different sizes, the disproportioned Bodies of steams, grate upon the nervous Pores, and then the Sensation proveth ungrateful; so that the various Motions of Air impregnated with odoriferous Steams, are first entertained into the inward Membrane of the Nostrils, and thence transmitted by Fibres to the Trunk of Nerves, sprouting out of the *Medulla oblongata*, and are thence conveyed by Fibrils, continued through the *Fornix* into the *Corpus callosum*, the seat of the common Sense, apprehending the perception of the outward Organs, to be pleasant or unpleasant.

The sense of Seeing runneth parallel with other Senses, in that its object being in motion, maketh application to the outward Sensory, affecting it with gentle strokes, imparted by communion of Vessels to the inward Sensory; the act of Seeing being the Perception of Appulses, made on the nervous parts of the outward Organ; and the more excellent part of Seeing, being the inward apprehension, determining Appulses first made in, and then communicated from the external to the inward Sensory, therein compleating the act of Sensation, which I shall endeavour more fully to illustrate. The Rays of Light, the Object of Vision, being a contexture of most innumerable minute Bodies, consist of infinite lucide Particles, streaming out of Celestial Bodies through every Physical point of the Hemisphere, in which the lucid Particles impel each other, by an inexpressible swiftness of Motion, through the most numerous minute pores of the Air, continued to various opaque Bodies, into which the Rays of Light being not able to penetrate, do sport up and down in different positions of outward Surfaces, forming

forming several models of Light, commonly called Colours, as so many appearances, made up of diverse reflections of Light, proceeding from Prominencies and Cavities, from the Convex and Concave Surfaces of opaque Bodies, whose greater or less Asperities, causing fainter or deeper shades (as so many allays to the Light) do produce bright or dark Colours, flowing from the various reflections of Light, which carry along with it, the Figure of outward Objects, araised with Beams, presented to the Eye, under the form of a Pyramid, the Base relating to the Object, and the Cone to the Eye, so that the Rays, beautified with Colours and Figures of outward Objects, do intersect each other; and being of a subtle æthereal Nature, do penetrate the transparent Membranes and Humors of the Eye, which being of greater or less Density, do make different Refractions of Light, some bending towards, and others from the perpendicular, till at last these variously refracted Rays of Light, make their appulses upon the *Retina*, which is an expanded Coat, framed of many Fibres, as Tendrils sprouting out of the Optick Nerves, which being affected with the motion of Figured Light, do carry it up to, and through the *Medulla oblongata* and *Fornix*, to the common Sensory, lodged in the more inward Recesses of the Brain: where the strokes of modelled Light, made upon the *Retina*, are determined by an animal perception of the common Sense.

As to the Sense of Tasting, diverse sapid Bodies being broken into small Particles, and impregnated with salival Liquor, derived from the Glands of the Mouth: The extracted oily, and saline Particles, as they consist of various Figures and Magnitudes, represented in the ruder Cubes, Pyramids, Cylinders, Trigons, Prismes, Trapezia, Rhombi, of diverse Salts, do produce different Tasts, as they make various Appulses upon the inward coat of the Tongue, consisting of many Fibrils, of the Fifth pair of Nerves, First affected with the motion of sulphureous and saline Particles, in the Membrane of the Tongue, which is thence carried up by the communion of Nerves, unto the Base of the Brain, and afterward through its several Processes, to the inward Sensory, where the common Sense is seated, distinguishing the various strokes, First made upon the outward Sensory, and then imparted to the inward.

But the manner of Sensation in Hearing may be (as I apprehend) thus performed by various sounds, which are so many Collisions of Air, briskly recoiling from solid Bodies. And (as I conceive) these sounds being numerous Particles of configured Air, one part pressing another forward with great agility, may be styled *Radii*, which moving in straight lines into the Auditory passage, do make Appulses upon the *Tympanum*, as well braced by the various Contractions of the opposite minute Muscles, inserted into it, by which it is rendred stiff and tense, thereby disposing it to receive the different impressions of Sounds, being various models of Air, striking upon the outward Surface of the *Tympanum*; from whence the same Configurations of the outward Air, are imparted to the inward innate Air, which is a Cylinder made up of many *Radii*, confined within the *Tympanum*, and do move in a Pyramidal Figure, its Base being toward the *Tympanum*, and its Cone toward the *Fenestra Ovalis*, in whose minute passage the *Radii* of the innate Air, are contracted, and thence conveyed along the *Labyrinthus*, to another small *Meatus*, the *Fenestra Rotunda*, where the *Radii* of the innate configured Air, are again contracted to give the more brisk Appulses, upon the tender Membrane of the *Coclea*, composed of many Fibres, springing from the Seventh Conjugation, commonly styled the Auditory Nerves,

Nerves, by whose mediation the Appulses of variously tuned Air, First made upon the Membrane of the *Coclea*, are thence continued to the body of the Nerves, seated in the Base of the *Medulla oblongata*, through whose substance, and that of the *Fornix*, they are communicated by many continued Fibres, to the *Corpus callosum*, in which the common Sense is resident, judging and determining Sounds, the several Motions of figured Air, reflected from solid Bodies, making soft vibrations upon the *Tympanum* (and Fibres of the Membrane investing the *Coclea*) which are from thence handed by continued motion of Nerves and Fibres to the common Sensory.

CHAP. LVII.

Of the Chine.

Although my Intendment at this time is to Treat principally of the *Medulla Spinalis*, as an elongation of the *Medulla oblongata*, to which it is near akin in Substance and Colour; yet it may not be amiss (as Methodical) to say somewhat of the Chine, before we discourse the *Medulla Spinalis*, of the *Fistula Sacra*, before the *Funiculus argenteus*, of the fine Cabinet, as ambulatory to the more excellent Jewel.

The Chine may not be unfitly styled, An elegant Columnne (supporting the stately Frame of Mans Body) composed of many parts, the Vertebers of the Neck, Back, and Loins, as so many Joynts curiously adapted, and joynted to each other, and well wrought, as it were with excellent carved work, set forth in the great variety of acute, oblique, and transverse Processes, as so many regular Carvings (wrought upon the body of the Vertebers) so that the oblique protuberancies do on each side uniformly answer each other, and the ascending and descending ranks of transverse Processes, do mutually correspond in the same order, and elegancy of Figure. This Spinal Columnne is crowned above with a fair Chapital, beautified with the fine Globe of the Head, and supported below with a double Pedestal, as each is furnished with the *Os Femoris*, & *Cruris*, whose Super-bases are framed of the *Os ilium*, *Coxendicis*, and *Pubis*; and the inferior Bases of this curious Pedestal, ultimately supporting the pillar of the Chine, are the *Ossa Tarsi*, *Metatarsi*, and *Digitorum*.

The description of the Chine.

The Chine in its First production is very much different from that of Maturity, which I shall endeavour to make out, in giving my mean Sentiments of the first Rise, Increment, and Perfection of it. As to the First, it taketh its Conception from the more solid part of the seminal Matter, which being divided into diverse small Particles, is first indurated into many distinct membranous Joynts, as the more rough draughts of the Vertebres, which appear in the Second and Third Month; and then these membranous Articulations being more consolidated, grow in the Fourth Month Cartilaginous, which being impregnated with some saline Particles, give the early delineation of a bony substance, first represented in small points, not exceeding the heads of Needles; and afterward as the Cartilaginous Vertebers, receive greater accessions of saline Particles, they gain more solid

The first rise of the Chine.

Concretions enlarging their bony substance by insensible degrees, till at last they are turned wholly into Bone.

The parts of every Verteber.

Some, and no mean Anatomists, not being only curious in discovering the various substances, but the Bones too belonging to the Spine: *Fallopins* assigneth Three Bones to every Verteber of the *Fœtus*. And *Kerkingius* hath made the same observation in his Twelfth Chapter *De Spina Dorfi*.

Quantum, quo omni Fœtum Spina differt ab Adultis est ossium triplicitas, quæ in Vertebris omnibus reperitur: natura enim Cavitationem, qua Medulla Spinalis transeat fabricatura, a tribus ossificationem aggreditur partibus quæ postea in unum coalescentibus, vertebram quidem unam constituunt; tribus tamen, quæ ante coalitionem indita sunt nominibus, insignita.

The various Bones of the Chine, as some imagine.

The greatest Bone he calleth the Body, and the other Two, lateral Bones; *Prima pars interior Crassa, & in rotunditatem quandam compressa, vertebræ corpus dicitur, aliæ duæ ad externam dorfi partem vergentes, alæ, seu ossicula lateraliter dici possunt.*

The Cartilaginous substances of the Bones, are gradually turned into Bone.

But by the favour of these Great Masters, I make bold to add my *Calculus*, humbly conceiving, that the Vertebres of the *Fœtus* have not Three distinct Bones, but parts only, relating to the same Bone; which I apprehend after this manner; Some part of the Cartilaginous substance (of which the whole Verteber was primarily made) being turned into Bone before the rest, seemed to form so many distinct Bones, which afterward do coalesce into one entire Bone; And the Cartilaginous parts (interceding the Bone first formed) being turned into Bone, fill up the spaces, making the whole substance similar, and do complete the Compage of the Verteber, by rendering it one entire Bone.

The completion of the Verteber.

After the same manner Nature proceedeth in the Two inferior Articulations of the *Os Sacrum*, appertaining to the Chine of a *Fœtus*, each seeming to be framed of Five Bones, which were the first rudiments of each Articulation, in which some Cartilaginous Particles, as receiving more saline Atomes, do coagulate into Bone before the rest, and by degrees the remanent Cartilaginous parts, as they are impregnated with new saline additions, are concreted more and more into Bone, till at length they constitute one entire Body.

The whole Systeme of Vertebres is turned into Bone.

Thus having given you (*Pro modulo meo*) a prospect of the beginning, and progress how the single Cartilaginous Articulations are ossified; I shall now endeavour to shew you a glimpse, how the whole grisly Systeme (composed of many Vertebres, finely fitted to each other, and mutually tied by strong Ligaments) is by insensible degrees, as by so many intermedial steps, more and more concreted into Bone, as Verteber after Verteber receiveth new accessions of saline Particles, communicated to part after part by Arteries inserted into them: And it may be seen in a dead *Fœtus* (Three Months old or more) newly taken out of the *Uterus*, and dissected; how Nature commenceth a remarkable point of Ossification in the Sixth Verteber of the Back, and from thence groweth less, as it goeth upward to the Fifth Verteber of the Neck; so that at this time, the Four upper Vertebres do not express any Delineation of the least point of Bone in them; but if you lead your Eye downward, you may discern about the Sixth Verteber of the Back, the points, if we step from Articulation to Articulation, till we arrive at the Third Verteber of the *Os Sacrum*. But if in Dissecting the Chine of a *Fœtus*, we turn our Eyes from the Body to the sides of the Vertebres, it is a pleasant spectacle to see, how Nature useth a different method, in beginning her fairest draughts of Ossification in the *Atlas*, which grow dimmer

mer and dimmer, as they go down toward the *Epistropheus*, and so from Spondyle to Spondyle, giving out at last in a most minute point, before they come to the *Os Sacrum*, which yet remaineth Cartilaginous, as to the sides of the Vertebres; so that the *Atlas*, *Epistropheus*, and the Two next Spondyles of the Neck, begin the first draught of Ossification in the sides, when their upper and lower regions of their Bodies remain Cartilaginous. But after an inverted manner, the first steps being rendred bony, appear in the Body of the Three upper Vertebres of the *Os Sacrum*, while at the same time, the sides of the said Vertebres, are clothed with a tender Cartilaginous substance.

The upper Vertebres grow first bony in the sides.

The body of the Vertebres in the *Os Sacrum*, begin first bony.

In the Fourth Month the *Fœtus* hath the Cartilaginous sides of the Vertebres, concreted into Bone, which goeth downward, as far as the *Coccyx*; and above also to the body of the Third and Fourth Vertebres of the Neck, which exchange their soft Cartilaginous substance into a more solid bony Compage; and at the same time the *Atlas*, and *Epistropheus* remain Cartilaginous in the body of their Articulations; But in the Fifth and Sixth Months, the body of the *Epistropheus* groweth bony, while its dentiform Process, and the anterior Region of the *Atlas* remain Cartilaginous.

In the Seventh Month, the dentiform protuberance of the *Epistropheus*, and the body of the *Atlas*, change their more soft substance into Bone.

In the Seventh Month, the body of the upper Vertebres of the Neck turneth bony.

But in the Eighth and Ninth Months, the Sides and Body of the Vertebres of the Neck, Back, Loins, and *Os Sacrum* too, do more and more quit their grisly Compage, and receive greater degrees of maturity, in order to the Completion of the Bony substance, except the *Os Coccygis*, which for the most part remaineth Cartilaginous, bating the inward Region, where Two or Three bony points start up.

Thus I have given you in in some sort, a History of the various substance of the Spinal Verteber in a *Fœtus*, and their causes, and manner of their first Delineation, Increments, and farther perfection in the *Uterus*, where they are not so absolute, but they may receive a farther accomplishment after Birth, by reason the Chine, though distinguished into a number of Vertebres, yet wanteth the ornament of Acute, Oblique, and transverse; which if they were produced in the *Uterus*, the *Fœtus* lying in a Conglobated posture, and the Spine being placed in the form of an Arch, the Processes, and chiefly the Acute would but out, and give great disturbance to the *Chorion* and *Amnios* (those sensitive Membranes) which, as fine thin swadling Cloaths, do invest the tender Fabrick of the *Fœtus*, whom Nature being ambitious to preserve, without any annoyance, hath designed in the First Months only lines (drawn in the middle of a Cartilaginous substance of the Vertebres,) as the rough draughts of Processes, which are finished after the Birth, adorning the Spondyles with variety of protuberancies, beautified with fine carved Work of different Figures and Magnitudes.

The various Processes of the Spine, are formed after the birth.

The posture of the *Fœtus* in utero, is conglobated.

The Processes of the Vertebres are adorned with variety of shapes and sizes.

Having discoursed of the *Prima Stamina* of the Chine, and their Increment, and how far they are accomplished in the *Uterus*, now it may seem not improper to speak somewhat of the greater maturity of the Chine after Birth, when the Bones of the Vertebres grow more great and solid, and their Articulations more distinct and strong, beautified with variety of protuberancies, and the Figure of the Spine is more straight, according to our Great Master *Hipocrates*, who in his Book *De Articulis*, saith *εχέει καὶ μικρὸς ἰθυσκόλιος ἐστὶν. Spina secundum longitudinem recto obliqua est*; which cannot be received of the Figure of the *Fœtus in Utero*, where the posture of the Chine is crooked, arched, and somewhat round, which best suiteth the narrow Lodgings of the *Uterus*;

The Vertebres and Articulations, grow more solid after Birth.

The Chine is straight after Birth, in order to progressive motion in an erect posture.

The Figure of the parts of a Verteber is various.

The Processes are seated in the outside of the Vertebers, after the manner of Carved work.
† T. 71. F. 4. 11.

† F. 4. d. d. The oblique ascendent and descendent Processes.

† F. 4. E.

The dentiform Processes.

The Fisula Sacra or Repository, in which the Medulla Spinalis is lodged.

Uterus; Nature endeavouring to repose much in little; but this Figure is changed after Birth, when the *Fœtus* quitting its former confinement, the Chine hath freedom to expatiate it self; and in order to Mans going in an erect posture, groweth more straight, yet not so absolute, but the Vertebers have their position in and out, sometime bending inward, as in the Vertebers of the Neck, to support the *Gula*, and *Aspera arteria*; and in the Loins, to comply with the posture of the Trunks of the descending *Aorta*, and ascending *Cava*: But the Spondyles of the Back, and *Os Sacrum* bear outward, that by giving way, they may make roome for the Heart and Lungs in the *Thorax* above; and for the Bladder, *Uterus*, and *Anus* in the *Pelvis* below: The Figure of every Verteber is embellished with great variety, and are broad and plain in their upper and lower Regions, where they are articulated one with another to prevent Luxation, but are round and smooth in their inward Coasts, that in their more easy retired posture, they might give no disturbance to the noble and tender neighbouring parts of the *Gula*, *Aspera arteria*, *Pleura*, Lungs and Heart in the middle, and *Peritonæum*, *Omentum*, and Intestines in the lower Apartment.

But the outward Region of the Chine is much more remarkable then the rest, full of so many different, yet uniform Prominencies, and unevennesses, as if it were wrought with excellent Carved work, consisting of great variety of several Processes, which run treble in every Verteber; First, Four oblique †, Two ascendent, seated in the upper, and Two descendent in the lower parts of the Spondyle.

Next are placed Two transverse Processes †, springing out of the sides of the Vertebers, wisely formed by the great Architect, for the Origen and insertion of Muscles.

And last of all, is seated in the back part of the Vertebers, one acute Process, called the Spine †, from which the whole frame borroweth its denomination.

The Chine in Salmon, Cod, Basse, Mullet, Carp, Tench, Perch, and the like, is not bedecked with transverse and oblique Processes as their Vertebers, have only Two acute Processes, one sprouting out of the upper, and the other out of the lower Region, and are small oblong Bones, ending in acute Angles, and do all successively in their postures, incline from the Head toward the Tail of the Fish.

But in diverse flat Fish, as Turbut, Soles, Place, Flounders and the like, the acute Processes are not sprung out of the upper and lower Regions, but out of the sides of every Spondyle.

In a Kingston the Chine is much larger near the Head, and groweth smaller after a little distance, as it descendeth, and then continueth of an equal Magnitude, and is made up of numerous Vertebers, which are so closely joyned to each other, that they seem one entire Bone, and are endued with a quadrangular Figure, somewhat resembling a Cube, though a little thinner in bulke.

Toward the upper Region, on each side of the Chine were seated Two ranks of Processes, which I conceive may be truly styled Dentiformes, as resembling the Teeth of a Saw; immediately under these indented Processes, a Perforation is made all along, not through the middle, as in Man and Brutes; but above the Body of the Vertebers, the *Medulla Spinalis* is conveyed, as in a safe Trench, to immure it, in opposition to cross Accidents. And the Spine of this Fish is not only adorned with indented Processes above, but in the Sides with transverse Processes, every Verteber being beset with one on each side, which are very thin broad Bones, so rarely united with small Ligaments,

Ligaments, that they seem to be one thin Bone, curiously fringing the sides of the Vertebres.

The Vertebres are not only furnished with Processes, but with Epiphyses too, every Process having an Appendix to wait upon it, as an attendant.

The body of every Vertebra is beset above and below with an Epiphysis, and the transverse Processes are also attended with each of them one, and another crowning the Extremity of the acute Process.

And the Vertebres are not only endued with Processes and Epiphyses, but Perforations too, Nature being solicitous, not only to import vital Liquor into the *Medulla Spinalis*, but to export what is unnecessary for the preservation of it; as also nervous Liquor from the *Medulla*, to give Sense and Motion to other parts; upon which account, Perforations are made for the most part between the Vertebres (except in the upper ones of the Neck, and the lower of the *Os Sacrum*) for the Ingress of the Arteries, and the Egress of the Veins and Nerves; the *Sinns* are made in the sides of the Articulations in the lower part, and in the higher Region of the subsequent Vertebra, so that the Two Extremities of either Spondyle, do in a manner equally contribute to making the *Foramen*; each furnishing a Semi-circle, which being conjoyned, make the Cavity (interceding every Two Vertebres) of an orbicular Figure, suitable to that of the Vessels.

And if there be any inequality between the Two Vertebres, in making the Perforations, the lower Vertebres in the Neck may challenge the greater share, the Cavity being more deeply engraven in the inferior Vertebra; but the procedure of Nature is quite contrary in those of the Loins, wherein the higher Vertebra contributeth more largely to the Perforation of the orbicular *Sinus*, in which the Cavity engraven in the upper Spondyle, maketh Two parts; and that in the lower only a Third part of the Circle.

The substance of the Vertebres is more hard and solid in the ambient parts, but in their inward Recesses more spongy; and their extream parts are garnished with Epiphyses and Cartilages, which being thick and soft, do beset the upper and lower Region of the Vertebres, near their Articulations, to render their motion more safe and easy.

The Ligaments, being of a thick, strong fibrous Nature, and of a semi-circular Figure, do firmly bind the Vertebres above and below, to secure their Articulations against Luxation.

Having given you a History of the Processes, Epiphyses, Perforations, Substance, Cartilages, and Ligaments of the Vertebres, speaking their general Notion; I will now endeavour to give my Sentiments of them in particular, and of the *Os Sacrum* and *Coccyx*, the immediate Base and Foundation of the Spinal super-structure, which is rarely composed of Twenty four Vertebres, as so many Joynts finely set together with strong semi-lunary Ligaments, conserving them in their proper seats; lest being luxated, they should lose their motion, and prove very prejudicial both to the *Medulla Spinalis*, and to the other tender and noble neighbouring parts.

The Neck is framed to give a reception and security to the *Aspera Arteria*, in order to Respiration, and in diverse Animals, to supply the defect of Hands, conveying the Mouth to receive Aliment; whereupon Nature hath provided longer Necks, made up of more Vertebres for them; then for Men, as Learned *Vesalius* hath well observed in his Fifteenth Chapter *De Colli Vertebres*. *Non enim hic Avium Quadrupedumq; quibus longa obtigerunt Crura, Colli usum recensere propositum est, quamvis in re collecta promptum sit, naturam illis, quod manibus carent, Colli maxillarumq; longitudine ad cibum assumendum prospexisse.*

The Epiphyses of every Vertebra.
The Perforations of the Vertebres;

The external parts of the Vertebres are solid, and the inward more spongy.

The Ligaments of the Vertebres are strong and semi-circular.

The use of the Neck.

A description
of the Spinal
Vertebers.
The *Atlas*,
The *Musculi*
mastoidei, or
Flexors of
the Head.

The Tensors
of the Head,
The *Complexi*,
Splenii, *Recti*,
Majores &
Minores, and
Origination
and Inserti-
ons.

The *Sinus* of
the first Ver-
teber.

The Denti-
form Process.

prospexisse. The whole Systeme of spinal Vertebers may be called a fine, long Chain, made up of the two extreame parts of the upper and lower, of the Neck, and the *Os Sacrum*, and of two middle parts of the Back and Loins. Every part is composed of many links, the upper is that of the Neck, consisting of Seven Vertebers, resembling so many links, so firmly joyned to each other by the interposition of strong Ligaments, that their union is hardly to be violated. The first link of this vertebral Chain is named *Atlas*, so called from supporting the Globe of the Head, and is strongly articulated with it, by two small heads, propagated from the lower Region of the *Os occipitis*, and received into two *Sinus*, engraven on either side of that eminent Cavity, made to entertain the Dentiform Process; and these Two *Sinus* of the *Atlas* are very well fitted to the heads of the *Occiput*; whereupon they are so firmly fixed in their proper Cavities by Ligaments, that they cannot start up motions of the Head, which are performed forward in Flexion on the first Verteber of the Neck, by the *Musculi mastoidei*, which being long thick Muscles (arising partly out of the top of the Sternum, and partly out of the clavicle) do ascend obliquely by the Neck, and are inserted into the *Processus Mammiformes*, which being contracted, do draw the Head forward, pulling the Chin toward the upper part of the Sternum; so that in this posture, (according to *Galen*) we give our assent *annuendo*, and our dissent *remuendo*, by withdrawing the Head backward, celebrated in extension, by the antagonist Muscles to the *Mastoidei*, the *Splenii*, *Complexi*, *Recti Majores*, & *Minores*; the first taking their rise in a double Origen (partly from the Five Spines of the lower Vertebers of the Neck, and so many tops of the upper Vertebers of the Back) do terminate with oblique Fibres into the *Occiput*. The other Tensors of the Head, called *Complexi*, which being as (I conceive) many Muscles united into one, do borrow their Origenes from Four transverse Processes of the upper Spondyles of the Back, and from the acute Processes of the Seventh Verteber of the Neck, and are strongly inserted from the middle of the *Occiput* into the *Mammiforme Processes*; The *Recti Majores*, are short fleshy Muscles arising out of the Spine of the Second Verteber, and the *Minores* out of *Tuberculum* of the first verteber, are both inserted in the middle of the *Occiput*; so that the *Splenii*, *Recti Majores*, & *Minores*, *Complexi* (beginning in the Vertebers of the Neck and Back, and terminating into the *Occiput*) do in their Contraction bend the Head backward, by drawing the *Occiput* toward the Neck.

In the lower Region of the first Verteber, are engraven Two shallow *Sinus*, which are endued with an orbicular circumference, which doth not run perfectly equal, as being enlarged in its posterior Region, beyond the round convex of a Circle into these *Sinus*, incrusted with a Cartilage, the Two little Heads (sprouting out of the upper part of the Second Verteber of the Neck) are received: In the middle between these Two Heads, out of the superior Region of the Second Verteber of the Neck, springeth up an eminent high and solid Process, whence the Second Verteber was called by our great Master *Hypocrates*, *ὀδοντοειδής*, somewhat resembling a Dogs Tooth; and by *Galen*, *κονοειδής*, a *nucis pinei*, imagine: In the body of the first Verteber, near the back side of the great *Foramen* (conveying the *Medulla Spinalis*) Nature hath engraven a deep *Sinus*, fit to give reception to the large Dentiform Process, whose Surface is somewhat rough, out of which ariseth a Ligament tying to the *Occiput* this remarkable Process, which is surrounded with a solid round Ligament, resembling the Figure of a Nerve, contrived with admirable Artifice by the most wise Disposer of all things, to secure the *Medulla Spinalis*

Spinalis from any Compression, which else might have been produced by the violent motion of the Dentiform Process, had it not been covered by a softer Ligament.

This Dentiform Process in a Child new born, seemeth rather to be an Appendix then a Process, because an Interstice appeareth between the Process and the Second Verteber; and its production being of an after date, seemeth to be clapt upon the Verteber, and to remain some time as it were separate from it, which I conceive is occasioned after this manner: The Dentiform Process being first Cartilaginous, is last of all ossified near the Verteber; whereupon a Cartilaginous Seam intercedeth the Two Bones of the Verteber and Process, which being afterward concreted into Bone, filleth up the *Hiatus*, and perfectly uniteth the Verteber to the Process, making up one absolute Bone.

One and the first use of the Dentiforme Process, is to be a center of Motion, on which the first Verteber being pliant, freely playeth backward and forward; whence in my opinion, the First may be truly called *επιστροφικός* though divers Learned Anatomists have assigned this Title to the Second Verteber, which may be better denominated *Axis*, in reference to its Process, about which, as being immoveble, the first Verteber (firmly united to the *Occiput* by strong Ligaments) doth variously sport it self in oblique motions, performed by the *Musculi obliqui Superiores & Inferiores*, which taking their rise from the upper Vertebrae of the Neck, are carried with an oblique course, and inserted into the sides of the *Occiput*, so that the Heads of the Muscles being fixed to the Second Verteber (as to an *Hypomoclion*, or part immoveable) The Right oblique Superior and Inferior Muscles (being seated in an oblique posture, and terminating in the Right side of the *Occiput*;) when contracted must necessarily pull the Face toward the Right Shoulder; and in a contrary manner, the Left oblique Muscles (being antagonists to the former) terminating in the Left side of the *Occiput* by gently contracting themselves, do reduce the Face from the Right Shoulder to its middle posture; and the same Muscles being more strongly contracted, do draw the Face further toward the Left Shoulder; which various oblique motions of the Head, some call Rotation, though not so properly, because the motion of a Wheele is not made obliquely to and fro, like the Head, but is carried round in a circular Motion, and cannot be truly assigned to the Head, because every circle is composed of Three hundred sixty Degrees; therefore whatsoever Motion is performed circularly, must run through all these degrees, passing round the Shoulders on both sides; but the various oblique motions of the Head, successively acted, can make (as I conceive) at most not above 120 degrees, which is but one Third part of the Circle; and therefore truly cannot deserve the Title of Rotation, or Circular Motion, but only different oblique Motions, successively performed about the Dentiform Process, by virtue of the oblique Superior and Inferior Muscles of the Neck: And the straight motions of the Head in Flexion and Extension, are exerted upon the first Verteber of the Neck, Extension being celebrated by the Contraction of the *Splenii*, *Complexi*, *Recti Majores*, & *Minores*, and Flexion by the Joynt-motion of both the *Mastoidei*; but the lateral motion of the Head is not made upon the First or Second Verteber of the Neck, but by the mutual concurrence of all the Vertebrae, not by both the *Mastoidei*, as in Flexion, but by a single *Mastoideus*, which is derived from the top of the Sternum, and inserted into the Right *Processus Mammiiformes*, which by its Contraction pulleth the Head laterally towards the Right side of the Neck, and

The use of the Dentiforme Process.
The Verteber, called *επιστροφικός*.
The Verteber called *Axis*.
The motion of the *Musculi Superiores & Inferiores*.

The Head is not carried round in a circular Motion.

The lateral motion of the Head is made by one *Mastoideus* and the

the other *Mastoidens* terminating into the Left *Processus Mammiformes* by its motion, draweth the Head towards the Left side.

The middle part of the Spinal Chine is that of the Back, and is composed of Twelve links of Spondyles, (according to the number of Ribs) and is longer and greater then that of the Neck, by reason Nature deemeth it reasonable, that the greater should support the less.

The Vertebrae of the Back.

The Dorsal Vertebrae are distinguished by diverse Names, according to the Antients, the First being called *λοφία*, and the reason is given by Bartholine, *Quod aliis imminet*, and called *λοφία*, *Quod cristæ galli assimilatur*, saith Diemerbroeck. The Second Vertebra is stiled *μυχαλιδος*, *Axillaris*. The Eight subsequent Vertebrae are called *κοιλια*, *Costales*. The Eleventh, *αφρενις*, receiving its denomination according to Diemerbroeck, *Non ob rectam Spinam (ut putat Laurentius) sed quia in spinæ motu stabilis manet, Supernis & Infernis vertebris ab ea recedentibus in flexione, ad eamque accedentibus in erectione spinæ.* The Twelfth is named *διαζωτης*, *Percingens* (according to Bartholine) *a vicino diaphragmate.*

The Processes of the Dorsal Vertebrae.

These Vertebrae are decked with variety of transverse, oblique and acute, or spinal Processes, the same with those of the Neck, and differ in this, that the Transverse of the Neck are perforated to give reception to the ascending Arteries and descending Veins; and the acute are Biside, being divided, the better to entertain the various Origins and Insertions of numerous Muscles, arising from, or terminating into the Processes of the Neck.

The body of every Vertebra hath a large Sinus.

And moreover, the Body of every Vertebra of the Thorax, hath on each side a large Sinus, deeply Engraven, fit to lodge the heads of the Ribs; but the First, the Eleventh and Twelfth Spondyles are furnished with peculiar Cavities, cut on each side of the Vertebrae: For about the Superior Region of the first Spondyle of the Back, is engraven a Sinus, every way orbicular and deep, which being incrusted with a Cartilage, is fit to give admission to the round Head of the upmost Rib. And furthermore, at the Inferior Region of this Vertebra, another deep Cavity is engraven, rough, and uneven, by reason of diverse small Cavities (wholly destitute of any Cartilage) out of which ariseth a Ligament, securing the Rib in its proper Sinus; and in the same manner a round Sinus being hollowed in the Twelfth Vertebra, to receive the Apophysis of the Twelfth Rib, hath another Sinus engraven in the lower part of the Rib, out of which springeth a Ligament, to conserve the head of the Rib in its proper seat.

Beside these Sinus, are found many *Foramina*, piercing the fungous substance of the Vertebrae of the Back, through which, many Arteries and Veins have free egress and ingress to import and export vital Liquor.

The Vertebrae of the Loins.

Now succeedeth the other middle part of the Spinal Chain, composed of Five Vertebrae, as so many Links; *Fallopins de Ossibus Capite 20. Scribit se multoties observasse quod pro varietate numeri vertebrarum dorsi, etiam variet numerus vertebrarum lumborum: ut si undecem sint vertebræ dorsi, tum vertebrae lumborum sex inveniri. Si illæ tredecem sint, tum has tantum quatuor, si illæ duodecem, quod ordinarium, tunc has quinque reperiri.* But in reply to this, saith Diemerbroeck, *Hoc tamen perpetuum non esse liquet in Sceletis, quod hic Utrajecti Medico quodam observatur, in quo sunt duodecem dorsi, & sex lumborum vertebræ insignis magnitudinis.*

The Vertebrae of the Loins are eminent for thickness, and greatness, and are perforated with various holes.

The Vertebrae of the Loins do transcend those of the Back and Neck in thickness and greatness, being adorned with variety of small holes, to give the Arteries and Veins an entertainment to and from the inward Recesses of the *Medulla Spinalis*, to let in and carry out vital Liquor from the spongy substance

Substance of the Vertebres, which have articulations as well with one another, as with the last Verteber of the Back, and the first rise of the *Os Sacrum*. The Vertebres of the Loins have a greater freedom then those of the Back, ordered most wisely by the great Protoplast, in a looser Articulation, giving the Vertebres greater spaces to play in, for the more easy and useful Flexure of the Loins, which are embellished with shorter and less acute spinal Processes, but broader and thicker then those of the Back, from which the progress is managed with different postures in the Loins, wherein the Vertebres are articulated in their Inferior Processes laterally, with those of the subsequent Vertebres below; whereas the Vertebres of the Back are carried upward in their ascending Processes, into the *Sinus* of the upper Vertebres.

The *Os Sacrum* is a Compag most eminent for thickness and strength, as being a fit Base made to support the long, and admirable pile of Vertebres: it is decked with variety of Surfaces, being within smooth and concave, and without uneven and convex, and in the whole, beautified with a triangular Figure, broad in its Origen, and in its descent groweth more and more contracted, ending in a kind of obtuse Angle; It is composed of Six Bones, in some sort resembling the Vertebres of the Spine; these Bones may be easily separated in Infants, but do coalesce into one in those of mature age.

The *Os Sacrum* is not perforated in the Sides, but in its Anterior and Posterior Region, with large orbicular Cavities, made in the internodes, where the Bones are conjoyned for the reception of Arteries, and emission of Veins and Nerves. It is garnished in its sides with minute Processes, and in the Posterior Region with little Spines, as it were looking upward, which so dwindle one after another as they descend, till the lowest almost quite disappeareth.

The *Os Coccygis*, being so named from the crooked Figure, of a Cuckoos Beak, broad above and very small below, is framed of three Bones, (taking their rise in a broad Figure, and terminating into a Cone) which are inflected inward as a fit posture when we repose our selves in sitting.

The substance of it in Infants and Children is Cartilaginous, and when they arrive to greater maturity, it quitteth its softer frame, and is concreted into a bony Nature, and the triple Bone in Infants, doth afterward by degrees coalesce into one in persons of riper years.

This Bone is appendant to the *Os Sacrum*, with which it is conjoyned, by the interposition of a Cartilage, in so laxe a position, that it can give way in time of Parturition, and in the excretion of grosser *Fæces*.

Bartholine, *Spigellius*, and *Riolanus* are of an Opinion, that the looser conjunction of the *Coccyx* with the *Os Sacrum*, is the cause of the *Procidentia Ani*; but with the leave of these Learned Men, I humbly conceive, the principal cause of it, is the relaxation of the *Muscles*, whose Office is to retract the *Anus* after the ejection of gross excrements.

The *Coccyx* in other Animals consisteth of many Bones, which turning outward, and growing in length, make the Tail of Brutes, as Apes, Dogs, Cats, and the like, but most rare in Men, of which *Diemerbroeck* giveth a Narrative, *Caudam in infante recens nato, ad semivulnæ longitudinem vidimus, omnino similem Caudæ simiæ*, though it is prodigious in our Countrey to see Men deformed with Tails, yet common among the Indians, who account it an ornament, whereby the *Pudenda* are obscured, of which *Diemerbroeck* giveth this History: *Chyrurgus quidam, vir probus mihiq; familiaris, ex India orientali re-dux, bona fide mihi narravit, ut Insula Bornæ, locis a mari remotioribus*

montosis, nasci hominum genus, genus hominum caudatum, (ut olim accidisse apud Pausaniam legimus, e quibus egre captam virginem (sunt enim silvicola) ipse vidit cum cauda carnosam crassa spithamæ longitudine inter clunes reflexa, quæ anum & pudenda operiebat; usque adeo velari illa loca voluit natura.

The First use
of the Chine.

One great Use (to which the Chine is consigned) is to be a Casket, to preserve the more noble Utenfil of the *Medulla Spinalis*, as a part of eminent use in reference to Sense and Motion, produced by numerous Nerves, the outlets of the pith.

The Second
Use.

Another Use of the Spine may be to strengthen the stately pile of Man's Body (speaking the Great Wisdom of the Omnipotent Architect) in keeping its frame in an erect posture, which giveth it State and Beauty, by lifting up our Head as an elegant Orbe (the palace of Virtue and Science) graced with a fine Frontispiece of the Face, seated upon the top of the joynted Column of the Chine, framed of many Vertebres, wrought in rich carved Works of various Processes.

The Third
Use.

A Third Use of the Chine (as it is composed of many Joynts) is to give the Trunk of the Body the advantage of moving inward, in bowing or stooping, performed by the *Musculus Psoas*, which being much assisted by the weight of the Body and Head, the Trunk is brought forward by the *Musculi mastoidei*, which by their joynt Contraction, do bring the straight posture of the Vertebres of the Neck, to a kind of Arch, by which we speak our consent and reverence.

The Fourth
Use.

A Fourth Use of the fine System of Vertebres (as adorned with many *Sinus*, and Processes) is to give entertainment to the Muscles of the Loins, Back, and Neck, in various allodgments; and from these numerous Spondyles, the said Muscles for the most part, have their Originations from, and insertions into them; And these Vertebres being strong and solid Bodies, are the Center of Muscular Motion, performed in the Trunk of the Body and Neck, and are also the *Hypomochlia* of the erect posture of the Body, which is celebrated by the Tensors of the Loins, Back, and Neck, overpowering the weight of the Body, till they bring it to an equal ballance.

The Pathology
of the
Chine.

The chief part of Pathology concerning the Vertebres of the Spine, is Luxation, and principally, (as most fatal beyond the rest) is that of the first Verteber of the Neck, wherein the Two Apophyses, springing out of the inferior Region of the *Occiput*, start out of their proper *Sinus*, engraven on each side of the *Medulla Spinalis*, caused by some great stroke, or fall, or some other severe accident; whence the upmost Verteber being forced forward out of its proper place, compresseth the *Spinalis Medulla*, *Larynx*, and the *Musculi Cephalopharyngæi*, and *Sphenopharyngæi*, and stoppeth the passage of the *Aspera Arteria*, and hinders the Apertion and Dilatation of the Gullet attended with the loss of Sense and Motion, afflicting almost all parts of the Body, according to *Hipocrates*, in his Book *De Articulis*.

The Luxation
of the First
Verteber.

ἢ ὅτι ἐν τῷ ἀνωτέρω μέρει μᾶλλον τὸ λόρδωμα γίγνεται, πάντος τοῦ σώματος ἀκίνητος, καὶ νευραρτηριοὶ κινούνται. Quod si superiori Spinæ parte magis in anteriorem partem inclinatio fiat, totius corporis impotentia & stupor contingit. I humbly conceive this to be the ground on which the meaning of this great Oracle of Art was founded. Because the Brain is the fountain of nervous Liquor and Animal Spirits residing in it; whence their streams do flow out of them into the Origen first, and afterward into all parts of the *Medulla Spinalis*; whereupon a Luxation being made in the upper Vertebres of the Neck, immediately followeth a compression of the beginning of the *Spinalis Medulla*, and the Head of the current of nervous Liquor being dammed up, and the influx

The cause of
the Impo-
tence and
Stupor of the
whole Body.

of

of Animal Spirits intercepted, all the numerous pair of Nerves springing out of the *Medulla Spinalis*, and afterward branched into the Muscles of the Trunk and Limbs of the whole Body, grow stupid in Sense, and faint in Motion, upon a universal relaxation of the Spinal Nerves; And the Luxation also of every Verteber of the Neck (being near akin to the first, as running the same fate) is accompanied with horrid symptomes of lost Respiration and Deglutition, produced by the dislocated Vertebbers of the Neck, compressing the *Aspera Arteria* and *Æsophagus*, wherein the Breath, Speech, and Motion of the Aliment through the *Gula* are intercepted, by a violent crushing the *Aspera Artera*, and by hindring the Contraction of the *Musculi Æsophagi*.

The Luxation of the Vertebbers of the Neck.

But the most common and less dangerous Luxation is that of the Back, which laboureth under diverse kinds, wherein the several dislocations of the Spondyles of the Back, do hinder the various motions of the Vertebbers, and happen when they are wrinched out of their proper seats, either outwardly, inwardly, or laterally toward the Right and Left Side, caused by violent strokes, falls, and overmuch inflections of the Back; and in Infants by the imprudence of Nurses, in over-straight and unequal Swathings; and in Women by overmuch Lacing their Bodies.

The Luxation of the Vertebbers of the Back.

In the Dearticulation of the Back, called by the *Greeks* *κόβωσις*, the Vertebbers are turned out of the proper stations, toward the ambient part of the Back, which carrying the Origen of the Ribs, with the annexed intercostal Muscles outward, do hinder their free playing, producing a difficulty of Respiration; But if the dislocation be made inward, named by the *Antients* *λόρδωσις*; it is more dangerous, because by compressing the *Spinalis Medulla*, *Pleura*, Lungs, the *Aorta*, *Vena Cava*, with the Heart it self, it doth intercept the motion of nervous and vital Liquor, and according to the various parts compressed, produceth a *Stupor*, and *Paralysis* in some, and faintness, and want of vitality in others. But if a Dislocation of the Vertebbers of the Loins be made inward, there happens a frequent suppression of Urine and other Excrements, a coldness of the Feet and Legs, which do at last extinguish the purer flame of Life, warranted by *Hipocrates* in his Book, *De Articulis*, "Οσοῦσι δ' ἐς τὸ εἶσω σκολιαίνονται οἱ σπονδυλοὶ καὶ πρῶματος, ἢ καὶ ἐμπροσθεν πρὸς βαρέος, εἰς ὃν δέσιν ἢ σπονδυλῶν μέγα ἐξίσταται κέρτα (ὡς ὅτι τὸ πολὺ) ἐκ τῶν ἄλλων ἢν δ' ἐκστῇ μέγα, ἢ εἰς, ἢ πλείονες, θάνατον φέρει, ὡς περ καὶ περὶ τὴν εἰρητὴν γωνιώδης γὰρ αὐτῇ, καὶ ἐκ κωλύειν γίνεται ἡ θάλαττα, ἕα μὲν ἐν πύσιν τοῖς τοῖσι καὶ ἀπὸ πυτός μᾶλλον ἐχέται, ἢ τοῖς ἐξω κροφίσιν καὶ πόδεσ, καὶ ὅλα τὰ σέλεα φύχεται. At quibus e

A kind of Luxation of the Back called *κόβωσις*.

Another kind of Luxation of the Back, styled a *λόρδωσις*.

The Luxation of the Vertebber of the Loins, made inwards.

*casu, aut illabente aliquo pondere, vertebrae interiores in partem obliquantur, iis quidem plerumque vertebra non adeo multum ab aliis recedit, sive vero aut una, aut plures multum excefferint, hominem, velut ante dictum est, interimunt, cum in anguli, non in circuli flexum hæc dimotio fiat, iis igitur Urina & stercus, magis quam quibus exteriorum in partem gibbus fit, supprimitur, pedesq; ac crura tota magis perfrigeantur potiusq; ista, quam quæ dixi, mortem afferunt, The Sense of this great Author is, (as I conceive) that upon some slight accident, the Verteber is not much displaced, but upon a more violent assault, one or more Vertebbers are much forced inward out of their proper seats; so that the unnatural posture of the Verteber is not semi-circular, but angular, compressing the *Spinalis Medulla*, and the *Peritonæum* with the Ureters, (lodged in its Duplication) and the neighbouring Intestines giving a check to their peristaltick motion, and their protrusion of gross Excrements, and the more serous Liquor, distilling out of the Ureters into the Bladder.*

Great Luxations of the Vertebbers of the Loins, are attended with death, and if they be less, they are accompanied with suppression of Urine.

C H A P. LVIII.

Of the Medulla Spinalis, or Pith of the Back.

The *Medulla Spinalis* hath not the nature of Marrow.

The *Medulla Spinalis* is an elongation of the *Medulla oblongata*. The *Medulla Spinalis*, or Pith of the Back, is composed of Four orbicular Processes.

The *Medulla Spinalis* is not the Origin of the Brain.

The Pith of the Back. The Opinion of *Malpighius*, that the *Medulla Spinalis* is the origin of the Brain.

THE *Medulla Spinalis* was so entituled by the Antients, (as I conceive) because after a manner it resembleth Marrow, as it is contained in the Cavity of the Bones, though in truth it doth no way participate the nature of Marrow, whence *Hipocrates*, not without reason, disclaimeth this Name in his Book, *περὶ ἀρχῶν, διὰ τὸ τοῦ ἐν ἀνδραγίας καὶ αὐτῷ εἶναι μυελὸς ἔννομα, ὃ καὶ ὁμοίως πρὸς ἄλλω μυελῷ, ὅς ἐν τοῖσιν ἄλλοιςιν ὁδοῖται.* Et propterea neque nomen *Medullæ ei merito datum fuit, cum nulli alteri reliquorum ossium Medullæ similis sit*, The *Medulla Spinalis* being part of the Brain, is of a viscous nature, no way consisting of fat oily Particles, capable to be melted, and resolved (as Marrow) into a flame, though highly acted by an intense Fire; but Use being the great Master and Arbitrator of Language, I will take the freedom to keep the old appellation, as best understood; so that the *Medulla Spinalis*, or *Cerebrum elongatum* being a continuation of the *Medulla oblongata*, to its Origen, is derived thence as being a Neck, or long Process of it; but as *Bauhinus* will have it, it is made up of Four orbicular Processes, the two greater proceed from the anterior part of the Brain, and the other lesser ones from the interior part of the *Cerebellum*, which are united in the *Medulla Spinalis*, contained within the Skull. And the pituitous recrements distilling from the Third into the Fourth Ventricle (when too much burthened) do compress those tender productions, the prime roots of the *Medulla*, intercepting the efflux of the Animal Spirits into the Spine; and if the compression be universal, it begetteth an Apoplexe, but if only of the Processes of one side, it produceth a Palsie.

Learned *Bartholine* reviveth an old Opinion, which *Galen* refuteth in his Book *De usu partium*; that the *Medulla Spinalis* is the Origen of the Brain, and the Brain is not an *ὑπερῶς ἐκτετατόν* branched out of the *Medulla Spinalis*, as if that great fluid substance of the Brain should be squeezed through the narrow passage of the Brain, into the more large and freer space of the Skull, which squeezing, the Author conceiveth, to be the cause of the many Gyres, and *Anfractus* in the *Cortex* of the Brain.

And of the same sense with that of Learned *Bartholine*, is this of ingenious *Malpighius*, asserting the medullary Processes of the Brain to be a Compage, made up of many small flattish round Fibres, visible in the raw and boiled Brain of Sheep, Bullocks, and the like, but most eminent in the hinder Region of the *Medulla Spinalis*, contained within the Skull; from which as from a large collection of Fibres, those derive their Origen, and are disseminated through the substance of the *Cerebrum* and *Cerebellum*, and being propagated from the Four reflex appendages of the *Medulla*, variously sport themselves up and down here and there through the inward Recesses and ambient parts of the medullary substance of the Brain, till at last they lose themselves with numerous divarications in the *Cortex*, in the Seeling of the Brain and Ventricles, the Fibres incline toward the sides, and also branch themselves into the *Fornix*, which may be discovered in some greater Fish, in which some part of the Fibres, which creep over the Ventricles, tend upward

ward toward the *Cortex*, and make a decussation with those lower ones of the *Fornix*; These Fibres do not run all in length, but making many near approaches to each other, seem to be a bundle, and then divide again, and tending to the sides of the Brain, make divers incruations one with another, as is plainly conspicuous in *Pisce Carcharia*: and these in probability may have a continuity with the anterior part of the *Medulla Spinalis*, which *Malpighius* judgeth to be their principle, and after a manner he thus illustrateth in a Cabbage-plant, whose stalk in its Skin, *Cortex* and Pith, resembleth in some sort, the strong Ligamentous, and other coats, and pulpy substance of the *Medulla Spinalis*; and also out of the stalk sprouteth the orbicular Head of the Cabbage, composed of great variety of foliage, one being rarely enwrapped within another, but it is altogether unlike in Figure and foldings of the diverse foliage, to the compage of the Brain, in reference to its several Membranes, *Cortex*, *Corpus callosum*, *Speculum lucidum*, *Fornix*, Ventricles, *Medulla oblongata*, and the other Processes, which are so many plicatures of the Brain, either finely encircling each other, or inclosed at least in some part one within another; out of the Cabbage-trunk the *Succus Nutricius* is conveyed by some Sap-vessels, both into the substance of the Stalk, and by other Fibres, into the outward and inward foliage of the Cabbage-Head, at once giving nourishment and enlarging their dimensions, till they arrive their utmost *extremum*. but the motion of Alimentary Liquor in the Fibres of the Brain, is performed in a different course, the Order being inverted in the Brain from that of the Cabbage, in which the *Succus nutritivus* first moveth from below by Fibres upward, and in the Brain from above by Fibres downward; the roots of the Plant shoot into small Fibres disseminated in the Earth, from whence the Sap being strained through the Skin, and *Parenchyma* of the *Cortex*, as through a Colatory, passeth into the lignous Body and Pith, and from thence gradually moveth upward, made in the vessels by an Appulse; because one Particle of the Sap presseth the other forward, till it landeth in the Cabbage-head, and bedeweth the several enwrapments of Leaves by minute Fibres, branched through their whole substance. But the motion of the serous Liquor in the Brain is acted in a contrary manner, as it is transmitted out of the capillary Arteries into the *Cortex* of the Brain, where it is depurated, and Altered, as *per Manicam Hypocratis*, and then received into the roots of the Fibres (there taking their first rise, and afterward transmitted through the several plicatures of the Brain into the *Medulla Spinalis*, contained within the Skull, and thence the Animal Liquor distilleth downward into the more narrow parts of the *Medulla*, enclosed within the safe and rare repository of the Spine; so that the Instance which ingenious *Malpighius* gave in the Cabbage, to illustrate his Opinion, That the Brain, and *Cerebellum*, Are appendices of the *Medulla*, I humbly conceive is of no validity, because the similitude doth not quadrate; As the Fibres of the Plant have their progress upward through the stalke to the head of the Cabbage, but the Fibres of the Brain are implanted into the *Cortex*, where they have their principle of Radication, and are so many roots, from whence the Fibres are propagated, First to the *Medulla* within the Skull, and so downward to that of the Spine, which plainly evidence, that the Fibres do borrow their birth-right from the *Cortex*, and are thence distributed through the medullary substance of the Brain, to the *Medulla Spinalis*, a Process or elongation of the Brain.

And the Opinion of Ingenious *Bartholine*, and the other Learned Author, I humbly conceive, is fuller of exuberant phantacy, then solid judgment, by reason it seemeth very improbable that the Brain should be propagated from

The Fibres of the *Medulla Spinalis*; *Malpighius* illustrateth by a Cabbage.

The manner of conveying alimentary Liquor out of the *Medulla Spinalis*, is different in order, from that of a Cabbage.

The manner how the serous Liquor is percolated in the Brain.

The progress of the nervous Liquor through the Processes of the Brain, into the *Medulla Spinalis*.

The Fibres of the Brain are implanted into the *Cortex*, and propagated through the Brain into the *Medulla Spinalis*.

The more noble operations of the Soul are seated in the Brain.

All muscular Motion doth receive its chief efficient cause from the Brain.

The Authors Opinion.

The Succus nutritivus is first generated in the Cortex, and thence propagated through all the parts of the Brain.

The Medulla Spinalis is acted by Liquor coming from the Brain.

The Brain, and Medulla Spinalis have their conception at the same time.

The Medulla Spinalis is double.

The substance of the Medulla Spinalis.

the *Medulla Spinalis*, and the greater and more noble part should be the offspring of the more little in quantity and perfection; The rational operations, the elicit, and imperate acts of the Understanding and Will, and the Functions of the common Sense and phancy, are celebrated in the Brain, and only the sense of Touching and Motion are acted by Nerves, transmitted from the *Medulla Spinalis* into the membranous and carnous parts; and the nervous Liquor is first generated in the Cortex, and Medullary substance of the Brain, and thence propagated down into the *Medulla Spinalis*, and so transmitted to the numerous pairs of Nerves (sprouting out of it. And last of all, the Tendons of Muscles (made up of the concurrence of various Fibres of Nerves, derived from the *Medulla Spinalis*) when by several contractions they make different motions in antagonist Muscles, receive their irradiations from Animal Spirits, issuing out of the Brain into the *Medulla Spinalis*; so that all muscular motion is first acted by the Commands, and imperate acts of the Will seated in the Brain.

And lastly, I will speak more closely, in order to give a reply to the improbable conjecture of these Learned Men, earnestly contending, that the Brain is an appendage of the *Medulla Spinalis*, which can neither be a principle of Dignity, seeing the more eminent and noble acts of the Soul are exerted in the Brain, and not in the *Medulla Spinalis*, as it hath been lately demonstrated; neither can the *Medulla Spinalis* be a principle, *per modum scaturiginis*, when the nervous Liquor is first formed in the Cortex of the Brain, and thence conveyed through the *Corpus callosum*, *Fornix*, and *Medulla oblongata* to the *Medulla Spinalis*, which cannot be a principle of dispensation to the Brain; because the Brain doth influence the *Medulla Spinalis*, which cannot celebrate its operations of Sense and Motion, except the Spinal Nerves receive their first irradiations from the Brain, whose nobler functions ceasing in the stagnation of the *Latex nervosus*, cause an Apoplexy, and *Catalepsis*; the motion of the Animal Liquor being intercepted in its progress towards the *Medulla Spinalis*, the spinal Nerves lose their Sense and Motion, as wanting their wonted and due influence dispensed to them from the Brain: Neither can the *Medulla Spinalis* claim a preheminance over the Brain, *per modum originis*, which supposeth the *Medulla Spinalis* to pre-exist before the Brain, which can no way be reasonably granted, when in truth in this, neither of them can challenge a superiority over the other, they being truly Twins, and have their conception in the *Uterus* at the same time out of the seminal Matter, the true Origin of them both, at once giving them a first rudiment and delineation: *Quod & Cerebrum, & Medulla Spinalis ex limpidissima aqua in coagulum callosum condensentur*. As Great Dr. Harvey, our worthy Colleague, hath very well observed.

The *Medulla Spinalis* is vulgarly divided into Two parts, the First is the larger and more short, taking its rise at the termination of the Brain about it, and is Three or Four Inches long, which being the Origin, is contained within the Skull, and is improperly styled a part of the *Medulla Spinalis*, that being properly so called, which is lodged within the Spine, and passeth through the whole length of it, from the Vertebrae of the Neck to the *Os Sacrum*.

Its substance is much akin in colour, to that of the inward Recesses, and *Medulla oblongata* of the Brain, but somewhat different in solidity, being somewhat more compact, growing more and more firm, as it maketh its approach toward the *Os Sacrum*.

Its tender fluid substance, not capable of resisting brisker assaults, is immured

immured within strong Walls, being safely locked up within numerous strong Vertebrae, as so many small Cabinets finely wrought with rare natural Bone-work, excellently beautified with great variety of oblique, transverse, and acute Processes, to secure this fine silver Cord, (as the Wise Man styleth it) from the rougher approaches of outward Objects.

The case of the Medulla Spinalis.

Within the safer immurements of the more hard and bony substance of the Vertebrae; the more tender substance of the Medulla is enwrapped in more delicate Membranes, as so many soft Repositories, which are Four in number.

The Coats of the Medulla Spinalis are Four.

The First and most outward, is a strong membranous Coat, arising from the Occiput, as some conceive, where it is firmly tied to the upmost Vertebra of the Neck; but Learned Spigellius, deemeth it to proceed from the Ligaments of the Spine, to which the Medulla Spinalis is fastned, and therefore it is called *Ligamentosa*, in reference to its ligamentous Origen, consisting of many small ligamentous Filaments, rarely interwoven with a most curious and Divine Hand, striking them close, and making them one entire Membrane, keeping the Medulla tight from suffering any violation in the various flexures of the Vertebrae; this is immediately encircled, by the Second Membrane of the Medulla Spinalis, which is propagated from the Dura Mater, and is a much finer and thinner Coat than that of the ligamentous, and is joyned in divers places to the *Tenuis membrana* by the mediation of many membranous Fibrils: But between these Two Membranes a Third creepeth in, and interposeth it self, which is not discernible by a careless Eye, by reason of its great fineness; upon which account it is æmulous of a Spiders web, and therefore called *Aracnoeides*, adorned with numerous small Arteries and Veins, importing and exporting Blood to and from the Medulla; this Membrane is tied to the Dura mater by diverse nervous Filaments, before they insinuate themselves into the Membrane, immediately enclosing the Medulla, which is the Fourth and last Tunicle propagated from the Pia mater, and is curiously enamelled with great variety of small Arteries, which insinuate themselves into the most retired parts of the Medulla, bedewing it with vital Liquor; of which whatsoever is Luxuriant, is returned by the Veins, toward the right Chamber of the Heart.

The First Integuments.

The Second Coat.

The Third Coat.

The Fourth Covering.

The Medulla Spinalis is not one entire substance, but is parted long-ways down the middle into Two equal portions, by the interposition of the fine Membrane, propagated from the Pia mater, which when it hath encircled the surface of the Medulla, insinuateth it self into the most inward Recesses of it, the Pia mater being a kind of Mediastine, or Sepiment, which (passing down clean through, from the beginning to the termination of the Spine,) divideth the Medulla into Two equal, but distinct Provinces; but some are of Opinion, that the Medulla is one undivided substance, as being not parted by any manifest Fissure, which though it be granted to be small, as it is scarce discernible in a humane Medulla, yet it is more conspicuous in a Bullock, where it is plainly parted by the Pia mater into Two equal parts, until it arrive the Vertebrae of the Loins; so that on either side a Cavity may be discovered in the Medulla of an Ox gently boiled; with which I humbly conceive, that of a Mans holdeth some good Analogy, *Ut perspicue Clarissimus Pavius observatione Undecima. In viro, Anno millesimo Quinquagesimo Nonagesimo Nono dissecto, Spinalem Medullam, a Pia matre manifeste in duo latera divisam, apparuisse observavit.* So that each of these Two Provinces being severd by the mediation of the Pia mater, hath peculiar small vessels, Fibres, and Nerves, which have no intercourse with each other; and the fountain of the nervous Liquor being placed in the Cortex, and Medullary parts of the Brain, and the streams

The Medulla Spinalis is divided into Two equal parts.

The Medulla Spinalis of a Bullock is parted by the Pia mater.

Each side hath proper channels to convey the *Latex nervosus*.

streams do immediately issue from the *Medulla oblongata* to the *Medulla Spinalis*, divided into Two equal sides, and each of them hath proper Channels to convey the *Latex nervosus*, which never overfloweth the common Bank made by the *Pia mater*, seated in the middle of it: so that one side being afflicted with any obstruction or compression; the well side cannot contribute any nervous Liquor or Animal spirits, for the relief of the disaffected side.

The *Medulla Spinalis* is like the Brain in substance and vessels.

The *Medulla Spinalis* being an appendix of the Brain, is styled by *Galen*, *ὡς ὁ δευτερος ἐγκέφαλος*, *Tanquam vicarius Cerebri*, emulateth it, not only in substance, but in great variety of Vessels, among which the Arteries may seem to claim the priority, in paying a noble tribute of vital Liquor to the *Medulla*; of these Arteries *Galen* giveth a good account in *Lib. Decimo Sexto de usu partium*,

Παρ' ὅλων τῶν ὁδῶν τῆς μεγάλης ἀρτηρίας, ἣν ἀπὸ ἐκ τῶν ἀνδρῶν τῶν δώδεκα ἀρξάμενης, διὰ πόσης ποιεῖται τῆς ἐλάττω τῶν ὁδῶν, ἔτεροι τίνες ἀπονεμήσεις εἶσιν ἀγγείων σμικρῶν, εἰς τὸν ὥσπερ ἐκ δαίμονος, διὰ δὲ τῶν πᾶν γινόμεναι,

The *Medulla Spinalis* hath many diversifications of Arteries.

ἢ μίαν γὰρ αὐτῶν ἢ σμικρὰν ὁπίσω πέμπουσι τοῖς ἐλάττωις μυσί, *Per totum iter magnæ Arteriæ, quod a quinta Thoracis vertebra auspicatu, per totam spinam facit, aliæ quædam sunt vasorum parvorum propagines, in Spinalem Medullam prorumpentes, binæ magna ex parte divisæ, partemq; sui non exiguum retro mittunt ad dorsales Musculos.* Learned *Rolfincius* addeth, in vindication of *Galen*, That the Trunk of the *Aorta* is not immediately branched unto the intermedial spaces of the Four upper Ribs, which are supplied from the cervical Arteries. The opinion of the Antients was, That the Arteries and Veins of the *Medulla Spinalis* did borrow their original from those greater Trunks of the Loins, and did unite with the Branches of the internal jugular Vein, and carotide Artery descending as they conceived, into the Loins, which is very repugnant to the æconomy of Nature. Because the internal jugular Vein is a branch of the descendent Trunk of the *Cava*, and the carotide Artery, a Branch of the ascendent Trunk of the *Aorta*; that of the *Cava* deriveth its Origen from the Right Cistern of the Heart; and this of the *Aorta* from the Left, so that both Trunks propagate themselves upward in numerous branches toward the Neck and Head, and no ways downward toward the Loins, whose smaller Veins and Arteries take their rise from the ascendent Trunk of the *Cava*, and descendent of the *Aorta*. But *Galen*, a great Master of the Antients giveth a better account of the Spinal Arteries, *διήκουσι δ' εἶσω ὅσων καὶ τὰς συμβολὰς αὐτῶν, ἵνα περ*

ἔσονται ἕξω τὰ νεύρα, καὶ διττὴ καὶ ἐκείνων συμβολὴν ὅσων ἀπόρουσι, ὅπ' ἢ πρῶτα διττον, τὸ μὲν ἐκ τῆς δεξιᾶς τῆς ἐλάττωις μυῶν, τὸ δὲ ἐκ τῆς ἀριστερῶν· αὐταὶ πᾶσαι πέμπουσι συζυγίαι μικρῶν ἀρτερίων εἰς καὶ ὅλων τῶν ἐλάττωις ἰσχυρισμοῖς τοῖς ἐλαφιοτέροις τῶν ὥσπερ ἀνδρῶν, καὶ διήκουσι εἶσω καὶ τῆς φλεβῶν εἰς τὸ καὶ τῶν νοσήων λεπτῶν μινίσαν.

Penetrant autem intra ossa, quæ ipsa inter se committuntur, quaq; nervi inter foras feruntur duplexq; ad singulas commissuras est apophysis, quod & foramen est duplex, alterum quidem a dextris Spinæ prrtibus, alterum vero a sinistris: Hæ omnino quamplurimæ sunt per totam Spinam exiguarum Arteriarum conjugatione numero nervos, qui ex Spinali Medulla producuntur æquales.

The Apophysis of the Vertebra.

It was commonly judged by the Antients, that all the vertebral Arteries did only relate to the Brain, but Autopsy determineth the contrary; for upon the parting the *Caudex* of the *Medulla oblongata* from the *Spinalis*, Three vertebral or arterial Branches plainly discover themselves climbing up round the *Occiput*, and Two of them equally convey Purple Liquor, both to the Brain, and top of the *Medulla Spinalis*, but the middle Branch, as Learned *Dr. Willis* hath well observed, doth not arrive the Brain, but parteth from the association of the Two other vertebral Branches, and descending downward,

ward, addreſſeth it ſelf to the Spine, freely bedewing its nobler *Medulla* with a generous juyce.

Veſſels that concern the Spine are of a threefold order; Arteries, *Sinus*, and Veins.

The various
Blood-veſſels
of the *Medul-
la Spinalis*.

The Arteries
of the *Medulla*

The Arteries of the Spine, as ſo many Sanguiducts to convey the *Latex nervoſus* to the *Medulla*, are ſeated in the inſide and backſide of the *Thorax*, ſome above, and ſome below the Heart, thoſe above may be ſtyled the upper Arteries, being ſprouts of the aſcendent Trunk of the *Aorta* (ſpringing or ſhooting on both ſides out of the axillary Arteries) are called the Vertebral, which climbing up ſtraight towards the *Occiput*, do in their progreſs upward ſend a peculiar branch to every internode of the Vertebrae of the Neck; but the inferior Arteries placed below the Heart, in reſpect the deſcendent Trunk of the *Aorta* in his paſſage downward (leaning on the Spine) doth impart from its Baſe Two Branches, One to either ſide of every Vertebra of the *Thorax* and Loins; ſo that the Trunk of the *Aorta* being opened in diſſection, it is a moſt pleaſant ſight, in reſpect the various ranks of perforations, made on each ſide of the Trunk, are diſpoſed in a moſt elegant order.

The vertebral Branches of the aſcendent Trunk, and the lower of the deſcendent Trunk of the *Aorta*, paſſing all along the Spine, are double, ſending one Branch to the neighbouring Muſcles, and the other to the Vertebrae, which creeping through their internodes, is ſubdivided into Three other more minute Branches, Two of which are inſerted into the *Medulla Spinalis*, and the Third into the Membrane, inveſting the foreſide of the Spine.

The Arteries
of the *Medul-
la Spinalis* do
come from
the aſcendent
and deſcen-
dent Trunk
of the *Aorta*.

As to the numerous Arteries, inſerted into the body of the *Medulla Spinalis*, they have a double progreſs, and meeting on both ſides with great variety of nervous Fibrils, tend upward toward their Origen; and the leſſer Artery arriving the hinder ſurface of the *Medulla*, adorneth it with fruitful Capillaries.

The Arteries
of the *Medul-
la Spinalis*
have a double
progreſs.

But the other Arterial Branch, as being the greater and more eminent, as ſoon as it attains to the confines of the forepart of the *Medulla*, thence climbeth up with an oblique aſcent to the middle of the Fiſſure, where it encountreth ſuch another Branch, obliquely aſcending from the adverſe ſide of the Spine. Theſe Two branches (being of equal Magnitude) iſſuing from contrary ſides, and riſing both alike obliquely, meet together in one common Trunk, into which they are both inſerted with Two diſtinct Perforations, made into one common middle, and much greater duct, conſiſting of the leſſer Tubes of the Two other branches, which diſpenſe into either ſide, in their progreſs, many other minute Arteries into either ſide, which leaning on the *Pia mater*, are more deeply inſerted into the ſubſtance of the *Medulla Spinalis*.

Two branches
of Arteries
meet in a
common
Trunk.

In like manner many arterial Branches coming from both ſides of the Internodes of the Vertebrae, are united in the common channel, paſſing down all the length of the *Medulla Spinalis*, from top to bottom, of this common Trunk.

Learned *Bartholine* maketh mention of it in his Obſervations, calling it an eminent ſanguineous Veſſel. *Dorſi Spinalis Medullæ longitudinem vas inſigne ſanguineum perreptat, ex quo ramuli hinc inde elegantiffime a ſerie emittuntur, quemadmodum, cerebro ſupra diviſuram Medullæ Spinalis incedit, hoc vas ſanguineum, inſtar iſtius in falce cerebri: Ad latera utriuſq; alius ramus, ſed minor ejusdem membranæ longitudinem percurrit; ex quo utrobique pari modo ramuſculi per tunicam diſperguntur, an Medullam pertranſeant, haud liquido conſtat.* This great ſanguineous Veſſel, *Dr. Willis* calleth *Arteria Spinalis*, which I conceive is made up of many vertebral Branches, proceeding from both ſides of the Spine, and inoſculated into one Caudex, paſſing down along the Fiſſure of the

The Spinal
Artery.

The verte-
bral Arteries
in Beasts unite
in the *Medul-
la Spinalis*.

Medulla, so that where the Trunks of the vertebral Arteries are united (that happeneth sometimes above the *Medulla oblongata*, and often in the Neck upon the *Medulla Spinalis*) an Arterial branch somewhat greater then the rest taketh its course downward. And it is worthy of our remark, that in Beasts the vertebral Arteries unitethemselves upon the *Medulla Spinalis* in an acute angle, and then parting with each other for a little space, approach the confines on each side of the *Medulla*, and thence speak their returns and meet each other as they began in an acute Angle, making a Figure not much unlike a *Romboides*. And the reason, as I humbly conceive, may be probably this, Why the vertebral Arteries in their intermedial steps down the Neck, have a coadunation; First, as it were in a point, and then quitting their association with each other, more and more enlarge their intermedial space, making a circumference up the Neck again in a narrow point, that the nimble motion of a large mass of Blood in Brutes, may be retarded, and their rapid torrent being carried with greater force in a right current, might be rendred more gentle, as somewhat intercepted in the diverse windings and turnings of the vertebral Arteries.

The Third
Branch of the
vertebral Ar-
tery is dis-
pensed into
the *Chine*.

The Third branch belonging to every vertebral Artery, as soon as it hath made its entrance through the several Internodes into the Spine, is dispensed into the fore part of it, where it hath a double profection toward the Left and Right Region of the Spine, and in the middle of it the Two branches of this vertebral Artery passing transversly from either side, are united by an Anastomosis, in which both Branches have a correspondence one with another, so that all the Arteries conveyed down the whole length of the Spine, mutually associating in divers inosculation, do imbrace and receive each other, somewhat resembling a chain of many Rings, mutually linked together, as Dr. *Willis* fancieth it.

The Arteries
of the Spine
do often inos-
culate and re-
semble a
Chain of
Rings.

These numerous Arteries branching themselves overthwart from every internode of the Spine, are propagated in great length, running downward in various continued Mæanders towards the *Os sacrum*; and if an injection be celebrated into the *Aorta*, and from thence into the vertebral Branches of the Spine, receiving the tincture, it will give a pleasant prospect to behold the many exedrical Figures of the Arteries, seated immediately one below another, after the manner of Network, rarely wrought by diverse Branches, which often meeting with each other, and then parting again, make various flexures, and yet ever observe an order of six unequal sides, which is conspicuous in every Figure, which holdeth a kind of uniformity one with another.

An Experi-
ment.

Arteries of
the Spine
seem to be
wrought after
the manner of
Network.

And this admirable Plex of Arteries climbing up to the top of the Spine, containeth Two Branches, shooting themselves straight upward into the *Rete mirabile*, and Two others tending with flexures laterally to the *Dura mater*; but the other extremity of this Arterial plex, shooteth along the Spine downward to the *Os sacrum*, and is at last inserted with many Capillaries into the Membranes, investing the bones of the Spine.

Arteries of
the Spine are
implanted in-
to the *Rete
mirabile*.

But some may be so curious as to demand a reason, why both the arterial Branches passing through many internodes, in both sides of the Vertebrae, with oblique ascents, meet in a common Trunk, making numerous *Anastomoses* all along the Spine; and also why another considerable Artery creeping through the Vertebrae, is transmitted transversly in divers branches, which make many inosculation, both above and below, in various exedrical concatenated Figures, which are framed by the different turnings and windings of the Two transverse arterial Branches.

The Arteries
meet and
make nume-
rous *Anasto-
moses* all a-
long the
Spine.

To which I reply, humbly conceiving, that many inosculationes are made in the surface of the Spine; the greatest and most numerous arterial Branches, are disseminated through the coats of the *Medulla Spinalis*, to give it a vital ambient heat, which is rendered more soft, as the over-hasty course of the Blood is checked by frequent inosculationes of different arterial Branches, now and then associating, and afterward parting again, which make many different Mæanders, giving the Blood a curled motion, and kindly heat, proper for the delicate frame of the *Medulla Spinalis*, fraught with nervous Liquor, whose temper and course would soon be disordered, either by the violent motion, or extravagant heat of the Blood.

The use of the
Inosculationes
of the Spinal
Arteries.

Having discoursed the first rank of Vessels appertaining to the *Spinalis Medulla*, and of the various divarications, Figures, and *Anastomoses* of their Branches; Now the Second and larger kind present themselves, the diverse *Sinus*, belonging as well to this of the *Medulla Spinalis*, as to that of the Brain, which being ranked in the Spine, in a more elegant order than in the other, are so many intercessions passing between the Arteries and Veins, as suppletories to the last, to propagate the continued motion of the Blood, lest too exuberant a source should be settled in the substance of the *Medulla Spinalis*, the most wise Architect hath constituted diverse *Sinus*, as so many drains, to receive and carry off the overflowings of the Blood, which else would compress and stop the smaller Channels of the serous Liquor, and intercept its intercourse with the Nerves, impairing the Sense and Motion of the dependant muscular parts.

The *Sinus* of
the *Medulla
Spinalis*.

The use of the
Sinus.

The medullary *Sinus* descending on both sides of the Spine, from the upper Verteber of the Neck, to the lowest of the Loins, doth much resemble in Figure that of the arterial Plex, only I conceive, this consisteth of many unequal sides, and that of more various concatenated Orbs, formed, as I conceive, after this manner, every *Sinus* wheeling round, till is it conjoyned by a commissure of the vertebral Vein, perforated into the *Sinus*, from thence receiving streams of Purple Liquor.

The vertebral *Sinus* are accommodated with Two different venous Channels, the One is an in-let to import Blood from the fore and hinder surfaces of the *Medulla Spinalis*, into the *Sinus*: And the other Channel an out-let to export it out of the *Sinus* into the Veins; and in many Animals they converse one with another, by transverse Branches, mutually interceding the Two lateral *Sinus* passing down the Spine, whose highest part is continued to the lateral *Sinus* of the Brain, which is furnished with a double Duct, the one leading into the jugular, and the other into vertebral Veins.

The First ve-
nous Channel
belonging to
the *Sinus*.
The other ve-
nous Chan-
nel.
The enter-
course of the
Sinus.

But to what good are these *Sinus* designed? To which I take the boldness to give this reply; That the Blood carried by the impulse of the vertebral Arteries into the substance of the *Medulla Spinalis*, is thence conveyed by venous Pipes, as so many Sanguiducts into diverse *Sinus*, the larger Cisterns containing great reserves of Blood, till a depletion be made of the vertebral Veins; otherwise an inundation of extravasated Blood being made in the substance of the *Medulla Spinalis*, would give a check to the motion of the Animal Liquor, distilling into the instruments of Sense and Motion.

And these *Sinus* being already treated of, do most properly usher in the Third rank of Vessels, the Veins, because both the venous Ducts receiving the Blood (transmitted from the vertebral Arteries into the substance of the *Medulla Spinalis*) convey it into the *Sinus*, and from thence re-convey it, as from a larger Cistern, by the more minute Channels of the venous Ducts, into the vertebral Veins, to which the venous passages and *Sinus*, are not only akin in holding an intercourse, as receptive of vital Liquor, subalternately communicated

The Veins of
the *Medulla
Spinalis*

one

The Sinus are like Veins.

one to another, but are also more nearly related to each other in the same membranous Nature and Compage. The Sinus and their smaller appendages, being like the Veins in frame and use, are all reductory vessels of Blood, and do differ, as greater and less Cavities, the one seated within, the other without the Spine; and of these Vessels *Hipocrates*, the Great Master of our Art giveth a recital, in his excellent Book, *De Offium Natura*.

ἡ δὲ φλέψ ἡσὸν τὰς φρένας ἐπιτέταται τῇ ἀκρότῃ λαοκῇ καὶ νύμφῳ, διαπέμπουσα φλεβία διὰ τῶν ἄλλων σωματικῶν περικυμνωμένων. ἔνταυθα δὲ διὰ τῶν σπινδαλῶν πυκνοῖσι φλεβίοισιν ἐς τὸ νωπιῶν μυελὸν ἐγκρίσεται. *Vena hæc*

subsepto transverso ad Spinam extenditur alba & nervosa, in reliquum condensatum corpus venulas emittens undiq; per vertebrae Cerebri venulis in Spinalem Medullam hederæ in modum convoluta inseritur: Upon which, *Rolsincius* thus elegantly criticizeth and comments, ἐγκρίσεται *Phrasis inquit emphatica* κίωτος χυσοῦ χαρπὸς τοῖς κλημάσιν ἐνδύμωσι, *Hedera aureis Corymbis speciosa, viticulis suis alacriter scandit sursum, circum circa suam Coronans basin, cui innititur hand aliter venarum propagines aurorosei sanguinis fructibus ditescetes, ἐγκρίσονται, κίωτος δίκλω, Instar hederæ Medullam Spinalem amplectuntur, ejusq; membranæ tanquam Basi innixæ, alta petunt.* The fruitful Branches propagated from the Trunk of the *Cava*, creep through the internodes of the Vertebres, and climbing up the Coats of the *Medulla Spinalis*, crown their Base with their most tender wreaths.

The elegant divarication of Veins upon the *Medulla Spinalis*.

The Veins are propagated from the Sinus.

The Veins entring between the Joynts of the Vertebres, and of the *Medulla Spinalis*, address themselves to the Sinus, and receptacles of Blood, giving it a reception to reconvey it to the Right Ventricle of the Heart, from whence the ascendent and descendent Trunks of the *Vena Cava* derive their first rise, and from these greater venous Channels; the smaller vertebral Tubes are propagated, and the Trunk seated above the Heart, approaching the Subclavian, associateth with the vertebral Artery, and dispenseth several branches through every internode of the vertebres of the Neck, and implanting them into the Sinus.

A passage goeth from the lateral Sinus into the jugular Vein.

Furthermore, the top of the vertebral Veins arriving near the *Occiput*, is inosculated into the highest part of the vertebral Sinus, continued to the lateral Sinus of the Brain, from which also a passage leadeth into the jugular Vein.

The reason of the *Vena Azygos*.

The vertebral venous Branches in the Loins, are immediately derived from the Spine.

And lest these vertebral Veins should be insufficient for the exportation of Blood out of the Sinus, Nature hath formed other auxiliary Branches, which do transversely intercede the other Veins, as so many by-passages to return upon occasion the Purple juyce out of the Sinus, to the great Trunks, immediately handing it in the Right Cistern of the Heart. And because the Trunk of the *Vena Cava*, seated below the Heart, doth not after the manner of the *Aorta*, immediately rest upon the Spine, propagating Branches in a straight course to it: Whereupon the *Vena Azygos* is produced, sending forth a double Branch, which again subdivide themselves, furnishing the Muscles of both sides, and the Spine, with variety of Branches; and below the Region of the Kidneys, when there is room enough for the *Cava* to lean near the Spine, there is no farther need of the *Azygos*; the vertebral Branches in the Loins are immediately derived from the Trunk of the *Cava*.

C H A P. L I X.

Of the Nerves sprouting out of the Medulla Spinalis.

I Conceive it not amiss first to give some account of the nature of the Nerves in a common notion, before I discourse more particularly of the Nerves of the Spine, and their Orogen, and Divarications.

Nerves (as to their definition, which giveth their essence and specification.) are similar Bodies, instruments of Sense and Motion consigned to the reception and conveyance of Animal Liquor.

And as to their substance, it is whitish and solid, made of divers thin Filaments naturally tied to one another, with an innumerable company of fine Membranes, and are not perforated with any visible Cavities, but only furnished with many minute Interstices capable to receive Liquor between their Filaments, into whose intermedial spaces it may destill all along from the first rise to the termination of the Nerves.

All Nerves borrow their first Orogen and principle of dispensation either from the Brain, or its Process the *Medulla Spinalis*, which is *Galen's* sense plainly expressed in his Twelfth Book *de Usu Partium*, and the 4th Chapter:

Ἀρχὴ δὲ τῶν ἀνθρώπου νεύρων ἐγκέφαλος ἐστὶ καὶ τὰς παρῑσσεις εἰς αὐτὸν φέρει, οἷον εἰς αὐτοὺς πῖνα τῆς λογιστικῆς ψυχῆς; ἑλθούσης δὲ ἐκτείνεται οἷον πρέμνε πνὸς εἰς δένδρον ἀνίκοντα μετὰ τὸν σωματικὸν μυελόν, καὶ τὸ πρέμνε δὲ ὅλης τῆς ῥαχέως ἐκτεταμένον πάμπολλὰ μὲν ἀπορρίπτει νέυρα. καὶ ἀπὸ κλάδων πνὸς ἀποβλασθήματα μεμεζόμενα μύρια.

Principium ipsorum nervorum cerebrum est, ipsumque; velut in arbum anima rationatrix semen emittit, germen vero inde, velut truncus quidam in arborem magnam resurgens, Spinalis est Medulla, à quo trunco per totam Spinam extenso, Nervi quamplurimi deducti in ramorum quorundam in mille propagines distribuuntur; So that the long round body of the *Medulla* descending the Spine, may be well styled a Trunk, and the Nerves so many fruitful Branches sprouting out of it.

Some Anatomists of great Name, affirm the *Medulla Spinalis* to be one soft Simple undivided Body, especially in the upper part, but upon a curious search, I humbly conceive it probable to be a system of many small Fibers, whose intermedial spaces are filled with a tender viscid substance, not unlike that of the *Medulla oblongata*, whose Orogen the *Corpora striata* being dissected long-wise, are plainly discovered to be full of many Medullary streaks, as so many small Vessels dispensed through the substance of the *Medulla oblongata* and the orogen of the *Spinalis Medulla*, contained within the Skull, and also the whole length of it carried down the Spine; but these Fibers are so minute, that they are scarce discernible in the inward recesses of the *Medulla Spinalis*, but are most evidently visible in the lower ranks and in the exterior regions of it, which are fraught with numerous small Fibres, and being united, make up the several vertebral Nerves, and as they are more or less in dimensions, have greater or less number of Fibres, which are very visible toward the surface of the *Medulla*, but more obscure in the inward recesses of it, in which probably they take their first rise, where every Filament

The description of Nerves.

The substance of Nerves.

The orogen of Nerves.

The Composition of the *Medulla Spinalis*, is Fibrous.

ment, I conceive, is again compounded of many more minute Fibrils dispersed through the whole substance of the *Medulla*.

The reason of
the *Medulla*
Spinalis.

The Brain being confined within a small circuit, is not able to furnish the larger and more remote territories of the whole Body with Nerves, and hath kind of second Brain, the *Spinalis Medulla*, which is deputed a substitute to it, out of which many fair Branches of Nerves shoot forth, as out of a common Trunk.

Every Ver-
teber hath a
pair of
Nerves.
The whole
Spine hath 30
pair of
Nerves.
The first and
second pair
of Nerves.

And every Verteber of the Spine challengeth as its propriety a pair of Nerves; so that the Vertebres being Thirty in number, have Thirty Conjugations of Nerves, Seven appertaining to the Vertebres of the Neck and Twelve to those of the Back, Five to the Loins, and Six to the *Os Sacrum*.

The first and second pair of Nerves passing through the *Occiput* and *Atlas*, and the *Atlas* and *Epistropheus*, the first and second Vertebres of the Neck, by reason of their peculiar Articulations, have different Perforations from those other Nerves of the Neck, Back, and Loins. These being lateral, but those made in the fore and hinder region of the two upper Vertebres, whose articulations would have been rendred more weak by lateral perforations, and so less able to receive the motion and support the weight of the Head.

The Fibres of
the first pair
are implanted
into many
Muscles.

The first pair of Nerves easily cutteth its way, between the highest Verteber of the Neck and the *Occiput*: And this first Rudiment out of the Seminal Matter being membranous, easily yieldeth to the passage of the nervous Filaments, which make up the first pair of Nerves, which running between the *Atlas* and the *Occiput*, are reflected somewhat before it passeth upon the Spine, and is divided into two small Branches, the one being very slender, passing backward, communicateth many Fibres to the *Musculi recti majores & minores, & obliqui superiores & inferiores*, which take their rise from the first and second Verteber of the Neck. The first being Tensors keep the Head upright, and the other moving together, are auxiliaries to the former, but acting Subalternately, make the short yirks of the Neck and Head.

A Branch of
the first pair,
is inserted in-
to the Flexors
of the Neck.

But the other Branch of the first pair of Nerves making its progress forward, is disseminated into the Muscles seated under the *Æsophagus*, the long and short Muscles, which bending the Neck forward, are truly entitled the Flexors of it.

The second
pair of Ver-
tebral Nerves
belonging to
the Neck.

The Second pair of Nerves are akin to the first in their manner of Production and Perforation, which are not lateral with most of the subsequent Nerves, but made in the exterior and posterior regions of the Spine, as best suiting the Articulations of the first and second Vertebres, requiring a greater strength as most nearly subservient to the various motions of the Head.

The origen of
the second
pair.

This Second pair is propagated from a double Origen, from the anterior a slender Branch slideth between the first and second Vertebres at the sides of the dentiform Process, is disseminated, associating with the Branch of the First pair of Nerves into the Flexors of the Neck, and afterward tending upward, diffuseth it self in many small Fibres into the Skin of the Face. But from the other Origen of the second pair of Nerves, which is the posterior and greater, passing by the side of the hinder Process of the second Verteber, are propagated two Branches, of which the larger bending transversely toward the middle of the Spine, where the *Splenii* associate, meeteth with a Branch of the third pair, and climbeth up toward the Ears, sending up fruitful Branches every way to the whole *Cutis* of the Head.

The

The Third pair of Nerves appertaining to the Neck, arise out of *Medulla Spinalis*, a little below those of the second, and have their first production in many small Filaments dispersed in the substance of the *Medulla*, and afterward being united on both sides of the Spine, creep laterally between the *Internodes* of the second and third Vertebrae of the Neck, and in a little space after their egress, are divided into two Branches, the anterior and posterior, the first of which is subdivided into four more minute Branches, of which the first distributeth divers Fibres into the Flexors of the Neck; The second taking its progress downward, intermingleth with a branch of the Fourth pair, and is inserted into the Muscles of the Neck, placed under the *Gula*; but the Third Branch climbeth upward, and associating with a Branch of the Second pair, crowneth the highest region of the *Cutis* of the Head with numerous Fibres. The Fourth Branch is implanted into divers Muscles, the *Mastoeidei*, *Cucullares*, and *Quadrati*; but the posterior large Branch of the Third pair bending it self backward toward the hinder part of the Spine, inserteth many Fibres into the *Transversales* and *Spinati*, the Extensors of the Neck, and afterward passing into the *Splenii*, the Extensors of the Head, from thence riseth higher toward the second Vertebra, and so going to the sides of the Neck and *Musculi quadrati*, is at last inserted into the Muscles of the Cheeks, called *Buccinatores*, which pull the Cheeks inward.

The Fourth pair of Nerves that concerneth the Neck, taketh also its first rise out of five or six or more Filaments first propagated out of the substance of the *Medulla*, and then all admitting a Coadunation about the sides of the Spine, do constitute a pair of Nerves which insinuate themselves between the Third and Fourth Vertebrae of the Neck, and presently after they are free from the Spine, each of them is parted into two Branches, and according to their different progress are styled the fore and hinder Branches; The former and larger is propagated into three other lesser Sprouts; of which the first entering into a confederacy with a Branch of the Third pair, do address themselves to the long pair of Muscles seated under the Gullet, which are Flexors of the Neck; A second Branch being a Sprout also of the anterior, is inserted into the short pair of Muscles, which are also Flexors of the Neck; and the *Trapezii* which by reason of great variety of Fibres, having a very different progress, can move the *Scapula* backward, and obliquely upward and downward. This Third and smaller part of the anterior Branch entering into association with a branch of the Fifth pair, and also a Branch of the Fifth pair falling into society with another of the Sixth, do all unite about the *Mediaſtine*, imparting a Branch to either side, and descending above the *Pericardium*, do for the most part constitute the Nerve of the Diaphragm, and are inserted into the nervous Body, or rather the Tendon seated in the Center of the Midriff, but the hinder branch of the Tenth pair of Nerves, is more slender then the anterior, as confined within a narrow compass, and ascending toward the Third Vertebra, imparteth its Fibres to the Extensors of the Neck, and thence climbing higher, is inserted into the *Buccinatores*, the Muscles of the Cheeks.

The Fifth pair of Nerves belonging to the Neck, ariseth under the Fifth Vertebra, and is divided into two Branches, the greater and anterior is implanted into the Flexors of the Neck, and into the *Deltoides*, and the Elevators of the *Scapula*, the *Cucullares*, &c. and imparteth a Branch to the Nerve of the Diaphragm; and the posterior and lesser Branch of this pair, communicates many Ramulets of Nerves to the Muscles of the Neck and Cheeks.

The third pair of Nerves relating to the Neck.

The third pair is divided into four Branches.

The Muscles into which the Fibres of the third pair are inserted.

The fourth pair of Nerves relating to the Neck.

The fifth pair of Nerves of the Neck.

The

The sixth pair
of Nerves of
the Neck.

The Sixth pair of Nerves, arising below the Fifth Verteber, maketh its progress into the Midriff, *Scapula*, and Arms, and into the hinder Muscles moving the Neck and Head, as also the Muscles ministerial to Respiration.

The seventh
pair.

The Seventh pair cometh out of the Chine under the Sixth Verteber, and associating with a Branch of the Sixth and Eighth pair, tends toward the Muscles of the Arm, and commonly sends a Branch to the Nerve of the Diaphragm.

The eighth
pair.

The Eighth pair of Nerves relating to the Neck (which some call the first of the Back, is emitted out of the Chine between the last Verteber of the Neck, and the first of the Back, and after a small space, is divided into two Branches; The anterior and greater is implanted into the Muscles of the *Thorax*; The posterior and smaller Branch doth impart many Fibres to the Muscles of the Neck and Back.

The first pair
of Nerves of
the Back.

Out of the *Medulla Spinalis* relating to the Back, arise Twelve pair of Nerves, The first sprouteth out between the first and second Spondyle of the Back) and hath two Branches, of which the anterior and greater transmitteth Branches into the Arm and Muscles of the Breast; and the hinder Branch sendeth Fibres into the Muscles of the Neck and Back.

Ten pair of
Nerves arising
out of the
Medulla Spi-
nalis of the
Back.

Ten pair of Nerves arising in order out of the *Medulla Spinalis*, make their Egress between the Vertebers of the Back, one below another, and every one of the said Nerves is divided into greater and less Branches, of which the first, being the anterior, distributeth many Fibres into the Internal and External Intercoastal Muscles, as also into the Pectoral, and oblique descending Muscles of the *Abdomen*, and the lesser and posterior Branches do dispencc numerous divarications into the Muscles and *Cutis* of the Back.

The twelfth
pair of Nerves
of the Back.

The Twelfth pair of Muscles, belonging to the Back (which some conceive to be the first of the Loins) ariseth between the last Verteber of the Back, and the first of the Loins, and is implanted into the Appendices of the Midriff, and the descendent Muscles of the Belly, and Loins.

And this pair of Nerves being compressed by a Stone lodged in the Kidney, causeth a numness in the Thigh of the same side, whereupon the Nerves of the neighbouring Muscles of the *Psoas*, being disaffected, do draw the *Iliacus Internus* into consent, which is a Coadjutor, as in Conjunction with the *Psoas* in the Elevation of the Thigh, and both these Muscles are endued with the same Nerves (arising out of *Medulla Spinalis* of the Back) whereupon they sympathize with each other, when disaffected.

Out of the *Medulla Spinalis* of the Loins, Five pair of Nerves do take their rise, and creep through Perforations of the Loins, seated one below another.

The first pair
of Nerves of
the Loins.

The first pair of Nerves do impart many Fibres to the Muscle of the Thigh and Legg, and to the Testicles, as also into Muscles of the *Abdomen* and Loins.

The second
pair.

The Second pair of Nerves doth by its anterior Branch distribute Ramulets into the Knee and *Cutis*, and into some Muscles of the Thigh and Legg.

The third
pair.

The Third pair is the strongest and largest of all the Nerves of the Back, and sendeth a number of Fibres into the Muscles of the Thigh and Legg, as also to the Groin, *Scrotum*, and *Cutis* of the *Penis*.

The

The Fourth pair of Nerves, belonging to the Loins, have their Egress through a hole between the *Os Coxendicis*, *Pubis*, and *Ilii*, and enter into the Muscles of the Thigh, and *Penis*, as also the Neck of the *Uterus*, and Bladder of Urine, and *Cutis* too.

The fourth pair.

The Fifth pair of Nerves (which some attribute to the *Os Sacrum*) by reason they make their Egress between the last Vertebre of the Loins, and the first of the *Os Sacrum*, and emit many Fibres, which confederate with the Nerves of the Legg, and distribute many Ramulets into some Muscles of the Thigh and Belly, and into the *Cutis* encircling the *Musculi Glutai*.

The fifth pair.

Out of the *Medulla* (lodged in the Cavity of the *Os Sacrum* as a safe repository) Five pair of Nerves do borrow their Origen, and every one of them is divided into an anterior and posterior Branch.

Five pair of Nerves arise out of the *Os Sacrum*.

The anterior upper Nerves are dispensed into the Legg, and the two inferior into the Muscles of the Bladder and *Anus*, and into the neck of the *Uterus*, *Scrotum*, and *Perineum*.

And the hinder Nerves are implanted into the Muscles of the *Nates*, as also into some extensors of the Thigh.

The termination of the *Medulla Spinalis*, doth send out a single (which is therefore called *Nervus sine pari*) which is first divided into Two Nerves, and afterward into more Branches, imparted to the *Nates*, *Anus*, and some Muscles of the Thigh.

The last of the Vertebral Nerves is single, and so called *Sine Pari*.

C H A P. LX.

Of the Nervous Liquor.

HAVING given you a Narrative of the several Processes of the Brain, *Cerebellum*, *Medulla Spinalis*, and the Nerves springing out of them; The Nervous Liquor now seemeth to offer it self, of which I have discoursed already, and will give now a farther account, as the perfection of all the parts of the Brain, *Cerebellum*, *Medulla Spinalis*, giving them Vigor, Motion, and Life, productive of the sensitive, motive, and intellectual acts, the consummation of the rest.

The various
choice liquors
of the Body.

The prime Liquors of the Body are the Lactescent, Vital, and Animal, which subalternately and mutually propagate each other, the Chyle being the *Materia substrata* of the Blood, as the Blood is of the Animal Liquor, and the Animal subservient to both, it being so wisely disposed by the Maker of all things, that they should be dependant upon and assisting each other, and mutually act various scenes of Life, Motion, and Nutrition, as they intimately espouse a mutual interest, and by various steps accomplish each other.

In the Animal Liquor three things may especially seem worthy our remark; its first production and propagation, or motion from part to part, and the uses to which it is designed.

The *Materia
Substrata* of
Animal Li-
quor.

As to its production it is derived from Blood (as its *Materia substrata*) which is made up in a large notion of two parts; of the red Crassament as more fierce and Sulphureous, and of an Albuminous Liquor, consisting in more mild serous Particles.

The manner
how the Ner-
vous Liquor
is made.

The Vital Liquor is forced by strong contractions of the fleshy Fibres of the Heart, out of its left Chamber into the ascendent Trunk of the *Aorta*, running in a hasty current as out of a great Cistern into a smaller Channel, through which the most spirituous Particles (mounting up through the Carotide Arteries) are carried through the Skull, and Coats, as into the Cortical Glands of the Brain, as ingenious *Malpighius* will have it (and as others, no less Learned) into the substance of the Spirits of the Brain fraught with many minute Pores, entertaining the Cristalline Liquor, the more soft part of the Blood, is impelled out of the Extremities of the Capillary Carotides, into the empty spaces of the *Cortex*, where it being extravasated, the subtle Particles of the Cristalline Liquor, holding a due proportion with the extremities of the Cortical Fibrils, are severed from the more gross albuminous Matter, and red Crassament of the Blood, (which being of unequal Figure and Magnitude with the minute passages of the Fibrils of the Brain) are returned into the Capillary Jugulars, streaming downward toward the right Cistern of the Heart.

The Liquors
are received
into the Ex-
tremities of
the Vessels, as
they hold ana-
logy with
them in size
and shape.

The Animal
Liquor is im-
proved by Mo-
tion, and im-
pregnated by
Volatil Salt in
the Brain.

The Animal Liquor being first generated in the *Cortex*, is afterward propagated by motion, through the different Processes of the Brain, receiving greater and greater refinement by Motion, because this choice Liquor passing through the smaller *Meatus* of the *Cortex*, in which it is streined, as through a fine Colatory, and then destilleth out of several Plexes of minute Cortical Vessels, as through so many Serpentine Ducts, into the small Parti-
cles

cles of the *Medulla*, variously intermingled with the *Cortex*, where it is impregnated with volatil Salt, and thence transmitted through the *Corpus Callosum* into the *Corpora striata*, and *Cruna*, and Trunk of the *Medulla oblongata*, which are rarely Enamelled with an innumerable company of streaky Lines, being so many Fibrils of small Vessels, the Rudiments of Nerves; and between the Interstices of these most thin Filaments, the Animal Liquor continued to the Nerves about the Surface of the *Medulla oblongata*, insinuateth it self with a soft stream between the Coats of the Instruments of Sense and Motion, which act more or less briskly, as they are more or less invigorated with a greater or less proportion of Animal Liquor, which if it be more then is requisite for Completion of the Nerves proceeding from the *Medulla oblongata*) it is thence communicated to the *Medulla Spinalis*, being a continuation and elongation appendant to the former, and the superabundant Animal Liquor is first conveyed by secret Nerves through the substance of the *Medulla oblongata* to the *Medulla Spinalis* lodged within the Skull, and thence destilleth along the *Medulla* seated within the Spine, and so propagated out of its substance by minute passages, first into the various Filaments seated in the inward Recesses of the *Medulla*, and is afterward continued to the Nerves of the Spine, which are so many systems of Fibres, taking their first rise from the more inward part of the *Medulla*, where they are divided into many small Branches, and afterward united into one common Trunk about the Surface of the *Medulla oblongata*, to whose hinder part the *Cerebellum* is fastned with two Medullary Processes, as with a double stalk, by whose mediation the *Cerebellum* holdeth an intercourse with the *Medulla oblongata*, in dispensing to it an Animal Liquor first produced in the *Cerebellum*.

The numerous Fibrils of the Brain coagulated into Trunks about the *Medulla oblongata*.

The purer part of the Blood is impelled out of the *Aorta* into the many divarications of Vertebral Arteries into the *Cortex* of the *Cerebellum*, wherein the more serous and saline Particles are discharged into the Glands, and the more gentle albugineous, holding a due configuration and magnitude with the Cortical Pores of the *Cerebellum*, are thereby strained, and received into them, while the more gross parts of the Purple Liquor being of a different figure and greatness, are excluded these Pores and discharged into the Jugulars; but the Animal Liquor, exalted with Volatil Salt in the *Cortex* of the *Cerebellum*, is thence dispensed by Medullary tracts into two large *Meditullia*, through which it gently destilleth by two small Medullary Processes into the *Medulla oblongata*, whence it is conveyed into the several pairs of Nerves, derived from it.

Thus I have given you some account of the motion of Animal Liquor, and of its several Gesses from part to part through the various Processes of the Brain and *Cerebellum*, into the *Medulla oblongata* and *Medulla Spinalis*, by whose mediation it is carried into numerous Nerves.

It may now seem not altogether improper to give you my meaner thoughts concerning the cause and manner of its motion, which may be celebrated as well out of its innate disposition as a fluid Body (solicited downward by its own weight from the ambient to the more retired and lower parts of the Brain and *Medulla Spinalis* and their appendant Nerves, as also forced thither by an impulse caused by the Arteries, inserted into the *Cortex*, where the Animal Liquor hath its birthright of the more gentle, separated from the more sulphureous part of the Blood, and receiveth perpetual increase made by a constant repeated propagation of new Liquor, as one part successive presseth another forward, whose more thin and subtle substance may easily insinuate

The manner of the motion of the Nervous Liquor.

The contraction of the Brain.

insinuate it self into the minute Pores of the Brain, especially when it is continually prompted forward by the softer motion, and gentle constriction of the Brain; which some Learned men have not faith enough to believe, denying all motion to it; but others more Candid, say it is only immovable of it self, being not acted with a proper natural motion, yet grant it an accidental one, proceeding only from the contraction and relaxation of the Arteries; and this is very evident to Sense: It hath been often observed in wounds of the Head, wherein the Brain being divested of its Skull and more immediate Coats, its motion is most plainly discovered, which keepeth the same order and measure with the pulsation made in the Wrist, which if that be slowly or hastily performed, the motion of the Brain is commensurate to it, and the Pulse ceasing in the Wrist, at the same moment, the Brain is wholly deprived of motion.

The Compage of the Brain is Fibrous as well as the Medulla Spinalis.

The Brain as Fibrous, is capable of divers motions.

And I do most humbly conceive, that the Brain cannot only be acted with an accidental motion, performed by contraction of the Arteries, whereby the neighbouring parts of the Brain being tender, are jostled to and fro according to the vibration and relaxation of the confining Vessels, but the Brain is also capable of a natural motion, notwithstanding its soft friable substance, which is interlaced and supported with great variety of Fibres, whose Interstices are only filled up with a kind of white tender *Parenchyma*, but a great part of its Compage is made up and embroidered with Medullary streaks, which I conceive are minute Fibrils, and especially the *Corpora striata*, as the two Origenes of the *Medulla oblongata*, whose whole Body as well as the *Medulla Spinalis*, is for the most part as it were a System of Fibres, the proper machines and natural instruments of Motion, which being of a soft and tenacious temper, are flexible and pliant, capable of various motions, contraction and relaxation, though the last is more remiss and mild, tending to an acquiescence in the restitution of them to their due and natural Figure, because in contraction the Fibres of the *Medulla oblongata*, somewhat changing their postures, situation and dimensions, are in a very small degree rendred shorter in length, thicker in depth, and crooked in figure, and being invigorated, grow tense and stiff, gently curling towards the Origen of the Nerves, no ways discomposing the delicate structure of the Brain; whence the *Medulla*, being a Compage of Fibres, is obnoxious to variety of tender motions, celebrated in many contractions and relaxations, according to the frequent command or silence of the Will, hasting the mild streams of Animal Liquor through the more straight Pores of small Fibres into the freer Channels of greater Nerves.

Some heavy Body, thrown into a collection of Waters, presently disorders the Surface, giving them greater or less curled motions, the neighbouring drops waisting one another forward with more or less violence, as they are acted with the more less pressing weight of the heavy Body, and at last the pressure of the weight growing faint, the motion of the Water is rendred weaker, till it hath smoothed it self into a natural and even current.

The Will being affected with the prosecution of some weighty good, discomposeth the natural Surface of the Fibres of the Brain, by giving them a curled figure in contraction, hasting the motion of the Animal Liquor more or less, according to the more or less powerful commands of the rational Appetite, which as they grow more remiss and easie. The Figure of the Fibres is more straight, and restored to their natural Figure, and neighbouring drops of the Animal Liquor crowding with less force upon

upon one another, return to their more gentle, natural motion, and even current.

Having Treated of the Production and Propagation of the Animal Liquor, and its motion through the several Processes of the Brain, and its continuation (the *Medulla Spinalis*) into the appendant Nerves, I conceive it will not be amiss to give you a short account of the Ends of it, how the Animal Liquor officiateth with the Rational, and Sensitive Operations; how it is also ministerial to Muscular motion, and Nutrition.

The Soul of Man, the Divine Image, and Empress of the lesser, the Epitome of the greater World, keepeth its Court and Tribunal in the supreme Orb of the Head, where (by the assistance of spirituous, subtle Particles, the more refined parts of the Animal Liquor, actuating the inward Recesses of the Brain) the more Divine Essence of Man celebrateth its Elicite and Imperate acts; The first consisting in the knowledge of its own nature and perfection in reflex acts, as also of the causes of other Beings without it self, artificially acquired in many different Sciences, specified by several Objects and deeper abstractions, made by subtle Conceptions of the Understanding; and also the imperate acts are performed by exalting the *Medulla* of the Brain with the more pure part of the Animal Liquor, by whose vertue the rational Appetite giveth its commands and controll to the Sensitive, to the Irascible and Concupiscible faculties, moderating and governing their different operations, the various Passions of the inferior Appetite, which ought to submit to the more exact rule and conduct of the rational Power.

The Fancy being seated in the middle of the Brain, is fraught with Animal Liquor, impregnated with Volatil Salt and Spirituous Particles, which render it in a fit capacity to exert the operations of the Fancy, to perceive and judge the nature and distinction of numerous Ideas, which making different Appulses upon the various Nerves of the Organs of outward Senses, are thence derived to the Origen of the Nerves, to which the Fibres every where adorning the *Medulla oblongata*, are continued and reach to the *Corpus Callosum*, the seat of the Fancy, as I humbly conceive.

Learned Dr. Willis placeth the manner and reason of Sensation in the retraction of the Animal Spirits, acted with the impressions of sensible Objects. The words of this Excellent Author are these; *Sensuum ratio formalis consistit in Spirituum retractione, seu versus fontes suos refluxu: Ubicunq; enim objecti sensibilis impressio radiosæ huic contexturæ infertur, statim aut tota compages, aut illius portio quædam, quæ speciem admittat, nutare ac retroacta, veluti resilire in se & recedere cogitur.* But with the leave of this most ingenious Author, I cannot well apprehend how a Signature of a Sensible Object, imprinted upon the Animal Spirits seated in the outward Organs of Sense, can make them recoil towards their Origen, the Brain; whereas the Spirits as the more pure and exalted Particles lodged in the Animal Liquor, have the same motion with it out of the *Cortex*, through the *Medulla* of the Brain into the Trunks of the Nerves, afterward inserted into the Instruments of the outward Senses, from which (I humbly conceive) there can be no Reflux toward the Brain; because the Animal Liquor espousing the Spirits, as its purer and inseparable parts (streaming from the *Cortex* of the Brain through the inward Processes) is still carried forward by an Impulse, because one part protrudeth another forward into the Interstices of the Filaments of the Nerves, whose more minute Pores are not capable of receiving at the

The Soul keepeth its Court in the Head.

The more noble operations of the Soul.

The seat of the Fancy.

The operations of it.

Dr. Willis his opinion about Sensation.

The Author's opinion that there can be no Reflux of Animal Spirits.

same instant a contrary motion, a Flux, and Reflux of Liquor, while the reflux of Liquor at the same time must encounter an adverse stream (always flowing in the Spaces between the Fibres) forced downward by its own weight and the gentle constriction of the Brain; which is caused by the pulsation of small Arteries implanted in the substance of the Brain, whereupon it being difficult to make out (as I apprehend) the retrograde motion of the Animal Spirits, which supposeth a contrary motion of the Animal at the same time in the same Vessels; So that outward Sensation (as according to the Learned Author's Opinion) cannot be probably founded in the recoiling of the Animal Spirits from the Organs of outward Sense toward the Origen of the Nerves and *Medulla* of the Brain; But I most humbly conceive that it is more agreeable to the œconomy of Nature to constitute Sensation in the motion of various, outward, sensible Objects, making different strokes upon the Fibres of Nerves, implanted in the Organs of Sense, and thence continued to the original of the Nerves and Medullary Processes of the Brain; where the inward Sense being lodged, perceiveth and judgeth the different Appulses, made upon the Fibres of the outward Organs, and thence conveyed by the mediation of the same Filaments of Nerves to the Seat of the inward Sense, which holdeth an intimate correspondence with the outward, by the interposition of Nerves, continued from one to the other; And Sensation cannot be accomplished without the mutual concurrence and cooperation of the Fancy with the outward Senses; and Sense being used not strictly but in a Complex notion, doth in some kind comprehend the outward and inward Sense, whose conceptions and operations are not so separate, but they do involve and presuppose each other.

The nature of
Sensation.

But to speak more fully to the nature of Sensation, I conceive its *ratio formalis* consisteth in Action and Passion, *ἐν τῷ πρῶτῳ καὶ ἐν τῷ δεύτερῳ*. which are not really distinguished, but are different Modes, affecting various Subjects; The one being the causality of the Agent, is styled Action, which being transient, passeth from term to term, and is called Motion; and as it is received into the term to which 'tis propagated, is denominated Passion. The outward sensible Objects, consist not only in the representation of Colours, but in Sounds, Odors, Savors, which are compounded of minute Bodies, as active *effluvia*, endued with certain Magnitudes, Figures, Postures, and Motions, making impressions upon the various Contextures of the Sensories of Sight, Hearing, Smelling, and Tasting, and those minute Bodies flowing from sensible Objects (being restless in activity) are transmitted from Subject to Subject, from Agent to Patient, and are received into the Pores of numerous Fibres, as they are commensurate in magnitude and figure to those Bodies, streaming from the outward Objects of Sense; and upon this account the *Effluvia* as different in Magnitudes, Figures, Positions and Motions, make various Appulses upon the Fibres of Nerves (which being invigorated by Spirits seated in the Animal Spirits, are rendered tense and stiff all along the Fibres) receiving the first strokes made by Sensible Objects in their Extremities inserted into the Sensories, and thence the Appulses are continued to the Origen of the Nerves, and Fibrils, implanted into the *Medulla* of the Brain; So that a motion, made in the end of the Fibres, placed in the outward Sense, are propagated to the beginning of the Fibres of the Brain, (where the inner Sense inhabiteth) is one continued action, not unlike a Vibration made in the termination of a Musical String, which is immediately conveyed to the beginning of it, so that an impression made by an Idea in the outward Sensory passeth in a moment by the continued

nued intermedial steps of Nerves, to the Fancy, watching in the middle of the Brain, somewhat near the original of the Nerves, which perceive all Appulses made upon them, by the motion of the Ideas, derived from Sensible Objects distinguishing and judging of their several qualities and proprieties, by the different Modes of their impressions.

And the Animal Liquor is not only an instrumental efficient cause of the rational and Sensitive operations, but of the Motive too, consisting in Muscular motion, wherein you may view the Wise œconomy of Nature, as the Sensitive and Motive Powers, are subordinate to the rational, and do all agree according to their primitive constitution in a most excellent harmony.

The Golden Chain of the four prime faculties of the humane Soul, is made up of four Links, two superior, the Understanding and Will, and two inferior, the Sensitive and Motive Powers. The inferior humbly speaking Obedience, in submitting their meaner Operations to the more wise Dictates and Imperate Acts of the sovereign faculty.

And I now shall take the boldness to entertain you with a short discourse of the other faculties, in order to the better understanding of the motive, which hath its dependance upon them, as precedent to it, in order of Nature at least, if not of Time; Sensation both outward and inward, being ministerial to the Understanding and Appetite, as they are imperative of the Motive, consisting in a Symmetry, and Harmony of the Object with the Organ. The manner and variety of Sensitive Perception is thus celebrated: The *Effluvia* being so many small Bodies steaming out of Sensible Objects, and being disposed with various figures and magnitudes move to the outward Organs of Sense, and are received into their Pores as holding a due proportion in the resemblance of figure and magnitude, and as the *Effluvia* of outward Objects, are exactly fitted, they gently touch the Sensory, by giving a pleasant operation, but if the unproportioned Objects roughly strike against the sides of the Pores, they make a harsh Sensation in the Sensory, a fine Contexture of many minute Fibres, which as they are acted with strong or weaker Appulses, make brisker or softer Vibrations upon the Nerves continued from the outward Sensories to their situation in the *Medulla oblongata*, and thence to the Fibres dressing the more inward Recesses of the Brain, where the Fancy is seated, which entertaining these strokes, presenteth them to the Understanding, and as they are Good or Evil, are judged fit to be embraced or refused, and accordingly represented to the Appetite, which according to the dictates of the Understanding, layeth her commands upon the motive faculty, which is exerted by virtue of contracted Fibres, the immediate Machines of Muscular motion.

But the difficulty is, how the motion of the Muscular Fibres is performed, and what is the efficient cause of it; which I conceive to be the more spirituous Particles of the Animal Liquor contracting the Fibres of the Muscles.

The Brain and its Appendages of the conjoyned Nerves seem in some kind to resemble an inverted Tree placed with the Roots upward and Branches downward.

The numerous Capillary Vessels spreading themselves in the Coats and Cortex of the Brain and *Cerebellum*, seem in a sort to represent Roots, out of which the Animal Liquor (being percolated from the Purple through the fine strainer of the substance of the Cortex) destilleth through the whole body of the Brain and *Medulla Spinalis*, as through a greater and smaller continued Trunk, into various Nerves, as so many greater fruitful Branches, and into abundant Fibres as so many smaller Twigs, and also into innumerable united Fibrils making the rare Contexture of Muscular outward Coats, somewhat

The Animal Liquor is an efficient cause of the Rational, Sensitive and Motive Operations.

The prime Faculties of the Humane Soul.

The manner of Sensitive Perceptions.

The efficient cause of the motion of Muscular Fibres.

The Brain and Nerves seem to resemble an Inverted Tree.

The Cortex is the Strainer of Albuminous Liquor of the Blood.

The Compage
of the Brain is
Fibrous.

The progress
of the Fibres
of the Brain.

The propaga-
tion of the
Animal Li-
quor.

The Nerves
are rendered
stiff and plump
by Animal
Spirits;

The progress
of the Animal
Liquor.

somewhat resembling Foliage overspreading the surface of the Muscles whose whole substance in its ambient and more inward parts is interspersed with a multitude of Fibres, of which a great part, if not all the *Medulla* of the Brain, is also composed, and they are the first rudiments of Nerves commencing in the Brain, where they are interlined with a soft white substance, a kind of *Parenchyma*, the more conspicuous part of the *Medulla*. These Fibres are propagated to the Original of the *Caudex* of the Nerves near the Surface of the *Medulla oblongata*, where is a Conjunction of many Fibres making the body of the Nerves, which are continued in their union all along to the surface of the Muscles, where they part again, and are disseminated through the body of the Muscles, and again unite themselves in a Tendon about the Extremities of them.

The Fibres of the Brain, Muscles and Membranes of the whole Body (as well as the *Caudex* of the Nerves) are made up of many minute Filaments, and through their Interstices, the Animal Liquor is first conveyed into the Fibres of the *Medulla* of the Brain and Spine, and thence propagated through the various Trunks of Nerves into the smaller Branches, the Fibres of the Muscles and their Tendons, being so many Systems of collected Fibres dispersed through the body of the Muscles and conjoined in their Extremities; So that the Animal Liquor impregnated with spirituous Particles streaming from the Brain between the Filaments of Fibres and *Caudex* of the Nerves, filleth their empty Pores, and rendring them plump and tense, putteth them into a capacity of motion.

The East blusheth at the Suns approach a little before it peepeth above the Horizon, and the early Rays, as so many minute *Effluvia* streaming out of that greater Body, diffuse themselves after the manner of an Orb, into the Air, araying it with a Robe of Light, whose reflected Beams carry along with it the Ideas of visible objects imprinted upon it, till it arrive the Organs of Sight, and being received into its *Pupilla*, and passing through several Membranes and Humors, maketh divers refractions, so that at last the gentle motion of these early Rays landing at the *Retina*, give but a soft touch upon the Fibres of it, causing gentle Contractions, but the brighter Rays as so many numerous minute Bodies more briskly breaking out of that glorious Luminary, do cloth the Air with a more splendid garment of Light, putting it into a nimbler motion, which hurrying the visible Semblances engraven on it to the Sensory of Sight, make greater appulses upon the Fibres, giving them stronger Contractions.

The Spirituous Particles of the Animal Liquor streaming out of the *Cortex*, diffuse themselves as in an Orb through the substance of the Brain, till they descend to the lower Region, where they are received into the Fibres of the *Medulla oblongata*, and thence conveyed through the body of the Nerves, to the Fibres inserted into the Muscles.

These lucid subtle Bodies of Animal Liquor somewhat representing the Morning Rays in their milder constant stream, destilling into the Muscular Fibres, act them with a gentle motion, consisting in a moderate tension of the Nerves and Fibres of the whole Body; but the *Effluvia* flowing from outward sensible Objects, make impressions upon the Fibres of the outward Sensory, and thence are ushered along the Nerves to the Brain, the Seat of the inward Sense and Understanding, by whose dictates they are recommended to the Will under the notion of Good or Evil, as to be desired or refused, whereupon the rational Appetite immediately giveth her commands to the Brain, solliciting its bright Spirituous Particles like the Rays, which as being more numerous, move with greater quickness into the fibrous parts of the *Medulla oblongata*,

dulla giving them stronger appulses and contractions, which being communicated to the *Caudex* of the Nerves terminating in Fibres into the substance of the Muscles, produce their brisk contractions and motions.

But the more gentle Emanations of Animal Liquor, fraught with many nimble Bodies, streaming into the Fibres, affect them with a gentle stiffness rendering a firmness in the Muscles, plainly discernible to the touch; As their plumpness giveth a sensible mild resistance to it, produced by a remission of the Fibres, commonly styled Tonick Motion; which I humbly conceive to be performed after this manner; We being awake, the motion of the Blood is more quick, carried by a stronger impulse of the Carotide Arteries out of the Coats of the Brain by the Capillaries into the *Cortex*, whereupon a greater separation of the Crystalline Humor is made, and more free streams of it are conveyed into the fibrous part of the Brain, making a universal gentle rigidity of them, and draw the body of the Nerves and Fibres into Consent, and make a universal easie stiffness of all the Fibres of the Body, giving the Muscles an innate disposition to Contraction, which would be acted to a greater degree, had not all Muscles Antagonists, making perpetual endeavours to contrary motions, but the contractions of the Fibres being of a like vigor, do equally resist and balance each others motions in their different tensions, and bring the several parts of the Body to easie postures in a pleasant acquiescence; but the more deep impressions of sensible Objects carried inward by the Nerves, to the Fancy and rational Appetite, under the notion of an Eligible Object, addeth Wings to the Animal Spirits and quicken their motion, into Fibres and Nerves implanted into particular Muscles: Of this I take the freedom to make an Instance in divers Musicians playing in Consort, the Musical Sounds making grateful appulses upon the *Timpanum* of the Ear, and are thence presented by the auditory Nerves to the inward Sense and Appetite, who giveth her commands to the Fifth, Sixth and Seventh pair of Nerves derived from the Vertebres of the Neck, and inserted into the Flexors and Tensors of the Wrist and Fingers, which do make different strokes, caused by the Bow upon the Musical strings of a Viol by the subalternate contrary motions of Flexions, and Tensions of the right Wrist, and do produce the different Musical Notes and Graces, and modelled Vibrations by divers stops and shakes upon the Strings made by the different tremblings of the Fingers, arising from the various quick successive motions of the Tensors and Flexors of the left Fingers; But it may be, some may expect an account of the causes and manner of these different motions of the Muscles, which I humbly conceive to be thus effected, The Will intending to move the Flexors making a quick recourse of the Animal Liquor, acted with Agile Spirits (giving speedy Appulses) invigorating the Nerves inserted into the Flexors, whose Fibres are so strongly contracted, that they over-power the antagonist Muscles, and relaxe the Tensors, who after the same manner, when they are subalternately moved, receive supplies of greater proportion of Spirits, making strokes upon the origin of the Nerves conveyed by their bodies to the Fibres implanted into the Flexors, which being more vigorously contracted, remit the more faint motion of the antagonist Muscles, as their former extraordinary supplies of Spirits are much exhausted.

The stiffness
of the Muscles
cometh from
the Spirituous
Particles of
Animal Li-
quor.

C H A P. LXI.

The Brain of Beasts.

HAVING in some sort given a description of the various Coats and Processes of Man's Brain; I intend at this time to discourse somewhat of *Anatomia Comparata*, that we may admire and adore the great attributes of the most Glorious and Omnipotent Agent, set forth in the wonderful production of the various frame of Brains in diverse Animals, of Beasts, Birds, and Fish, that we may see what agreement and disagreement they have with the more excellent Fabrick of Humane Brain, and thereby may render it more illustrious.

The Bodies of Animals, are more or less perfect, as they are like that of Mans.

The description of the Coats of the Brain of Animals.

The Cortex of the Brain of Brutes.

The Falciform-Process in Brutes, is furnished with nervous Ligaments and Cells.

Man, the Master-piece of the Creation, in reference to his more noble composition, and rare union of integral parts, is most eminently illustrious in the choice Coats and Processes of the Brain, in which he may be most truly styled, an Exquisite Standard, giving Rules and Measures to other Animals, which are Masters of greater or less perfection, as the parts of their Body, and processes of their Brain hold more or less proportion with those of Man, wherein the Brain of Brute-Animals, as Lions, Wolves, Bears, Leopards, Horses, Red and Fallow Deer, Bulls, Sheep, Goats, Hogs, and the like, do most excell, as running in some sort more parallel in similitude with Humane Brain, and do much comply with it in their Coats and Processes; For the upper Apartment of more perfect Animals, as well as Man, is embellished within, with the fine hangings of the *Dura* and *Pia Meninx*, every way encircling that more bright Orb, and are rare con-textures, neatly embroidered with Arteries and Veins, and made up of numerous Fibers, beset in many places with minute Glands, accompanying the the fruitful Vessels and Fibrils running long-ways, cross-ways, and obliquely, and are so closely interwoven with each other, that each of these thin vails, consisting in innumerable finely wrought Filaments, do seem to be one simple body, encompassing the Two Provinces, and Base of the Brain, which in Brutes are much of a less size, and different Figure from that of a Man; this being orbicular, and that of a more oblong, depressed round form, and is much lesser in circumference and Magnitude then the other. And the *Cortex* of Brute-Animals is beautified with many *Anfractus*, composed of a Cortical and Medullary substance, though less and shallower then those of Man, yet run uneven in many Mæanders, not unlike them in circumvolutions, as aping the Intestines; but Hares and Coneys, and other imperfect Animals, have various Processes of diverse sizes, and are somewhat like the *Anfractus* of Humane Brain.

The Two Provinces of the Brain in Brutes, being much depressed and less then those of Man, are parted in the middle with a falciform Process, lodged all along in a Fissure, less deep in Brutes then Men, in which the Falciform Process is plain, but in Bulls rough, being furnished with diverse strong nervous Ligaments, passing athwart from one side of the Process to the other; whence the *Sinus*, running wheeling up and down, with various little Processes, is, as it were divided into diverse small Cells, (which I conceive) are in the nature of minute Damms, causing the current of Blood to curl into diverse

diverse Mæanders to break its force and over-hasty motion, against the winding sides of robust Chords, which hinder the substance of the Brain, from being over-charged with luxuriant Blood.

And these nervous Chords, seated in the Falciform Process, having a power (as I apprehend) to contract and dilate themselves (produced by various sensitive passions) do draw the *Sinus* into different postures, and sometimes by lessening, and other times by enlarging the cavity of the *Sinus*, do in this hasten the gentle, and then again check in the other, the precipitate motion of the Blood.

The *Corpus callosum* in more perfect Animals, doth feel and support the lower Region of both Provinces of the Brain, and differeth not in Figure but in Magnitude, being narrower and thinner then that of Humane Brain.

The *Fornix* also in Brutes complieth in Form, but differeth in size from that of Men. And the Nativiform Processes exceed only those of Men in Magnitude; and when they are very large in Brute-Animals, as in Calves, Sheep, Hogs, &c. The Testiform-Processes are very small, being narrow appendices of the Superior oval Prominencies. It may be also observed, that when the Nativiform-Processes are great, as in Brutes, then the annular Process (encircling the Base of the *Medulla oblongata*) is small, and when the Nativiform-Processes are small, as in Men, the annular Process is large, above the *Glans pinealis*, which seemeth to be double; in a Rabbit are seated Four oval Processes, fastened to oblong narrow Processes, and the *Corpora striata*, and *Medulla oblongata* in more perfect Animals, are akin in shape to a Humane Brain, and are only somewhat less in greatness.

The *Cerebellum* of Brutes somewhat resembleth that of Man in the Vermiform-Process, and is different from it in the *Lamellæ*, which are a kind of Semicircles, or Segments of them, and are largest in the termination of the *Cerebellum*, and grow narrower, as they approach the Origen; and the Humane *Cerebellum* is distinguished also from that of Brutes in situation; that of Men being seated under the hinder part of the Brain, to which it is united above by a Process, and by another below to the *Medulla oblongata*; whereas the *Cerebellum* of Brutes is lodged beyond the hinder part of the Brain, to which it is conjoined only by its Origen.

So that upon a Survey being made of the Membranes and Processes of perfect Animals, and compared with a Humane Brain, they seem much to resemble it in Figure and Colour, and to differ a little in Dimensions and Consistence; the Brain of Man being greater and more firm and solid, then those of Brutes, which being opened in a very short space, grow very flabby, the *Anfractus* lose much of their Figure, and the whole surface abateth of its roundness and plumpness, whereas a Humane Brain long retaineth its orbicular Form, and more solid Consistence.

And yet for all these differences, the Coats and Processes of the Brain of perfect Animals do very much correspond in likeness with that of Man, which may seem to be very wonderful; that Brains so highly resembling each other should partake of such different principles and operations, the one being acted with a rational, and the other with a sensitive Soul; in the one the Understanding dictates to the Will, and the Will (when regular) commandeth by its imperate acts, the Irascible and Concupiscible appetite: And in the other, the appetite is swayed wholly by the dictates of the phancy.

In a Humane Brain, the Understanding in reflex acts, perceiveth, considereth, judgeth, approveth or condemneth its own acts, as consonant to, or dissonant from right Reason; of which, the meerly sensitive Soul residing

The nervous Chords of this Process have a power to contract and dilate themselves.

The *Corpus callosum* in Beasts.

The Nativiform Processes are bigger in Brutes then Man, and the Testiform are very small.

The *Cerebellum* in Brutes.

The situation of a Humane *Cerebellum*.

The substance of a Humane Brain, is more firm then that of Beasts.

The Coats and Processes of the Brain of Beasts, much resemble that of Man.

The sensitive
Soul of Beasts
is not capa-
ble of a reflex
act.

The nervous
Liquor and
Animal Spi-
rits of the
Brain of Men
are more spi-
rituous and
excellent,
then those of
Beasts.

T. 51.
The Brain of
a Calf.
taken out of
the Skull and
opened.
† F. 1. a a.

† b b.

† d d.

† e.

† f f f f f.

† g g g g g
g g.

† h h.

† F.

† i i.

† k k.

† F. 2. A A
A A A A A.

† a a a a.

† b b b.

in the Brain of Brutes, is no ways capable, and the imagination and common Sense, are not in the least manner perceptive of their own operations, as being not able to make any reflection upon them, which is the prerogative only of the Humane Soul, which exerteth more noble acts in the Brain of Man, and is of a more firm substance then those of Brutes, and improved with a more delicate nervous Liquor, highly impregnated with volatil, saline, and spirituous Particles, producing most excellent dispositions in a Humane Brain, rendring it fitly qualified to entertain the rational Soul, which being diffused through every particle of the Brain, (to which it is intimately united) exerteth in a most mysterious manner, by its bright irradiations, the Divine Operations of the Understanding and Will, giving Rules and Measures to the inward and outward Senses, and communicate a kind of Eternity to Entities in universal Notions, thereby making great variety of Sciences in many different abstractions, which impart a sort of Spirituality to things, by refining them from the grossness of Matter.

Near the Origen of the Brain of a Calf, on each side of the olfactory Nerves, are seated Two orbicular Processes †, endued with a white Medullary substance.

And about the Origen of the Brain near the Skull, is placed the *Os spongiosum* † full of small Cavities, made for the transmission of Air into the Ventricles, and for the discharge of Recrements out of them into the Cavities of the Nostrils into which are transmitted the olfactory Nerves † which do furnish the inward Coat of the Nostrils with numerous Fibrils, the immediate Organ of Smelling.

The Brain of a Calf and other Animals begins † in small Dimensions, and afterward enlargeth it self, and hath its outward surface rendred uneven, with many *Anfractus* † (as so many Cells of Blood-vessels for their greater security) which are not so deep as in a Humane Brain.

And about the Sanguinoducts lodged in the *Anfractus*, are seated many Vessels † full of serous Liquor, encircled with fine Coats, adorned with diverse shapes and sizes.

The Brain being in some part opened, the *Corpus striatum* † may be discerned out of its situation in the Left side of the Brain, in which being scraped, a great company of streaks † may be seen running cross-ways through the Medullary substance of the Brain.

The Medullary part of the Brain is beset with numerous streaks running cross-ways.

The Brain being laid open, the Natiform Processes † (appendages of the *Medulla oblongata*) are presented to our view, which are larger in Beasts then Men; these protuberancies have their lower Regions, encircled with the Testiform Processes †, as with Two Arches.

The Falciforme Process † of this Animal, as well as of other Animals, is made up of a double Membrane (which is a Duplicature of the *Dura mater*) between which are lodged a number of miliary Glands, besetting the inward surface of the Membranes.

About the middle of this Process, are seated many carnos Fibres †, (which have a power to move the *Dura Menynx*) accompanied with many Vessels; † This Process is much larger then that of a Humane Brain, and different in Figure from it, as no way resembling a Sickle.

The Brain of a Doe is beautified with Two Hemispheres † divided in the middle by a Fissure † in which is lodged a Duplicature of the *Dura Mater*, commonly called the Falciforme-Process.

The serous Vesicles † are placed about the Blood-vessels, lodged in the *Anfractus* of the Brain, and are adorned with variety of Figures, some being orbicular, or oval, others triangular, or pyramidal, and appear turgid, with a Liquor much like *Lympha*, embodied with particles of Air.

The Brain is first covered with a thick Coat (immediately encircling the *Pia Mater*) denominated the *Dura Meninx* † which being stripped off, the *Pia Mater* † appears (as being a fine vail, immediately encompassing the Brain) shaded with fruitful Branches of Blood-vessels †, which being adjacent to the many *Anfractus* † do resemble a fine Landscip in the *Pia mater*, when it is divested of the *Dura Meninx*, turned up, and placed at the margin of the Brain.

Near the Origen of both Hemispheres are seated Two medullary Processes † beautified with a triangular Figure, adjoyning to the olfactory Nerves †, inserted at last into the inward Coats of the Nostrils, beset with many Fibrils, the instruments of Smelling. These Nerves are parted by a bony Intersepiment †, called vulgarly, The Bridge of the Nose †.

The Fissure severing one Hemisphere from another, and taking its progress from the Origen, to the termination of the Brain, is beset with a great company of small Glands †.

Under the Falciform Process of a Doe, is lodged the *Corpus callosum* †, which consisteth of many parts, separated from each other by two Fissures, the First † being much shorter then the other, divideth some part of the *Corpus callosum* into equal parts, which seem to be endued with a kind of semi-lunary Figure, and their lower Angles adjoyn to the Origen of the Second Fissure.

The lower and longer Region of the *Corpus callosum*, is divided also into equal parts (by a long Fissure †) which begin in acute, and end in more obtuse Cones.

The medullary part of this Brain, when opened, is bespecked with many streaks †, passing cross-ways, which I humbly conceive are the nervous Fibrils of the Brain.

Under the *Corpus callosum* of a Doe, are lodged the *Corpora striata* †, the Apices of the *Medulla oblongata*, and have their Origens endued with obtuse Cones, and their termination in more acute; contrary to those of a Humane Brain, which begin in more acute, and end in obtuse Cones. The *Corpora striata* in this Animal have Two oblong productions † conjoynd to their terminations, which I have not seen in the Dissection of a Humane Brain.

When the inward penetrals of the Brain of this Animal are laid open, on each side of the *Corpora striata*, appears a white Medullary substance † enamelled with many white *Striae*, the fibrous Compage of the Brain.

In the most inward recesses of the Brain, are seated the *Thalami nervorum opticorum*, which are parted from each other by a Fissure †, going almost the whole length of the *Thalami nervorum opticorum*, which being considered as conjoynd, do constitute a kind of Triangle.

To the lower Region of the *Thalami nervorum opticorum*, are adjacent the Nativiform protuberancies †, which seem to be adorned with an orbicular

T. 52.
F. 1. The
Brain of a Doe
not opened.
† F. 1. aaaa,
bbb,
† cccc.

† ddd.
† e.
† ffff.
† gggg.

† i.
† ii.
† k.

† m.
F. 2. The
Brain of a Doe
opened.
† aaaa,
bb.

F. 3. † aa. The
inward Re-
cesses of the
Brain of a Doe
opened.

† bbb.

† cccc.

† aa.

† e.

† ff.

cular Figure; and to the hinder part of the Natiform Processes, are the Testiform † appendant, and seem to be of an oblong shape, much different from the Natiform prominencies.

† 88.

T. 53. F. 1. The
Head of a Spa-
niel Bitch
opened.

† F. 1. a a.

† b b.

† c c.

† d d d.

† e e e e e.

† f f f.

† g g g g.

† h h.

† i i.

† k k.

† l l.

† m m.

† N.

† o.

† o o.

† p p.

† q q.

† r r r r r r r r.

T. 53.
F. 2. The
Head of a
Cat open-
ed.

† a a.

† b b.

† c c.

† d.

† e e.

† f f f.

Two Medullary Processes †, somewhat resembling Glands, are situated near the Origins of the Brain, endued with obtuse Angles † under which do creep the olfactory Nerves, † running in length toward the Nostrils.

The *Anfractus* † of the Brain, are much shallower then that of Man.

In the Mæanders of the Brain relating to this Animal, are seated a company of Blood-vessels † divaricated into numerous Branches.

About the Ramulets of many Sanguiducts, may be seen divers vessels of *Lympha* †, or serous Liquor, encompassed with fine Membranes. Within the Brain, being opened, may be discerned a white Medullary substance † dressed with numerous streaks, as with so many Fibrils of Nerves.

Above the Origins of the *Thalami nervorum opticomum*, may be seen the *Corpora striata* †, beginning in large rounded Heads †, and closing in oblong narrow Terminations. †

The *Thalami nervorum opticomum* † seem to be seated between the *Corpora striata*, and Natiform Processes, to which they appear to be appended by Two Processes † as by stalks. And the *Thalami nervorum opticomum* are divided from each other by the interposition of Two or more semicircular Processes. †

These white Semicircular protuberances are also parted by the mediation of a Fissure †.

The Natiform Processes † confining on the *Thalami nervorum opticomum*, are adorned with a kind of Oval Figure.

The Testiform protuberances † are adjacent to the terminations of the Natiform Processes, which they seem to enclose as with a double Arch.

The *Cerebellum* of this Animal is framed of many Apartments, of which Two are seated on each side, and one in the middle.

The middle Apartment † is endued with a more large Origen, and ends in more large Dimensions, and is beautified with many oblong Processes, going transversely, and resembling Parallelograms in shape.

The lateral Provinces are composed of many ranks of Processes † which seem to be Five on one side, and Three on the other.

The *Cerebellum* of a Cat is composed of Five Apartments, one in the middle, and another in the termination, and Four lateral, Two on each side of the middle Apartment.

The middle Apartment † is adorned with many oblong transverse Processes, somewhat like Parallelograms in Figure.

The inward lateral Apartments † are endued with a kind of Semi-lunary Figure, and are endued with many oblong transverse Processes, more short then those of the middle Apartment, and somewhat akin to them in Figure.

The outward lateral Apartments † are accommodated with diverse ranks of Processes, endued with various Figures and Sizes.

The posterior Apartment † adjoyning to the middle, is greater and shorter then it, and is dressed with many Processes of irregular Figures.

The Testiform Processes † adjoyn to the Origen of the *Cerebellum*, and are mutually conjoyned by their Neck, and enclose the terminations of the Natiform Processes †, placed above them, and seem to be adorned with an oval

oval shape, above the Natiforme Processes I observed on each side of the Fissure, Two Semicircular, narrow, Medullary Processes, encompassing it.

The *Thalami nervorum opticom* † in a Cat, have their Butt ends approaching toward each other, and run obliquely cross-ways toward the sides of the Brain, and end in more acute Angles.

Their Butt-ends † approach near each other (as only parted by a narrow Fissure) and are encircled with a white Medullary Process.

The *Corpora striata* † are almost of the same Length, Figure, and Magnitude, with the *Thalami nervorum opticom*; to which the lentiforme Processes are adjacent, and their Butt-ends are parted from each other, by the mediation of a short and narrow medullary Process †.

The Brain being opened, at the Margent of it may be seen some remanent *Anfractus* †.

And within the *Anfractus* of the Brain opened, may be observed Two semicircular medullary Processes † of it.

At the Origins of the Brain are seated Two medullary Processes †, beautified with a triangular Figure.

Under these medullary Processes, do creep diverse Branches of the olfactory Nerves †.

The olfactory Nerves of a Pigg near their Terminations, do divide into many small Fibrils †, seated near the beginning of the Nostrils, for the greater advantage of a quick Sensation.

The Trunks of the olfactory Nerves † which creep up the Brain, and take their progress the whole length of the Nostrils on, each side of the grisly Interspiment † parting them.

A double Case † (is lodged near the origination of the Trunks of Nerves when crept out of the Brain) beset with many Cartilaginous lines, passing cross-ways within the said Case, as in a Cabinet, are kept Two soft medullary substances, not unlike that of the Brain.

About the Origins of the Brain are seated Two other Processes † (endued with an oval Figure, and a medullary Substance somewhat less then the other, contained in Two Cartilaginous Repositories.

About the circumference of the Brain (left unopened,) may be discerned some *Anfractus* † the allodgments of Blood-vessels † within the *Anfractus* (the Brain being opened) may be seen a white medullary Substance, consisting of many small Globules.

And if you divest the *Corpus Striatum* † of its Membrane, and gently scrape it, we may discover its surface enamelled with numerous streaks running cross-ways) which are a Systeme of nervous Fibrils.

And if the *Corpus striatum* be encompassed with its thin Membrane, many Blood-vessels † appear, shading the surface of the Lentiform Process.

Two oblong narrow medullary † Processes may be seen, which encircle a great part of the *Thalami nervorum opticom*, as with Two Arms.

And the Brain being opened, may be observed an oblong narrow Process † (like a Staff) going down from the Origin of the Brain, all along it, and between the Arms of the medullary Processes, and *Thalami nervorum opticom*, to the natiforme Protuberancies.

The *Thalami nervorum opticom* † are lodged between the Arms of the said medullary Processes, and the natiforme Protuberancies:

The *Thalami nervorum opticom*, are endued with a pyramidal shape and their Bases confine on the natiforme Prominencies, and their acute Cones, on the arches of the medullary Processes.

The

+ 00. The natiform Processes + (being adorned with an orbicular Figure) do adjoyn on the side of the Bases of the *Thalami nervorum opticom*; and on the other side to the Testiforme Processes +, which are appendages of the Natiforme Protuberancies, and are more longer and slender then the Natiforme.

At last, beyond the Testiforme Prominencies, appeareth a part of the *Cerebellum* +.

+ q.
T. 55. F. 1. The
Head of a
Rabbit open-
ed.

+ aa. Two Processes + of a Rabbit (endued with an orbicular Figure) do confine on the Origins of the Two Hemisphæres.

+ bb. On each side of these Processes doth appear a Compage of many Glands, + on which the Eyes do lean, as on soft Pillows.

+ cc. The optick Nerves + under the side of the Hemisphære, near their originations or points; and are inserted into the inside of the Eyes.

+ d d d d. The Hemisphæres + of the Brain seem to be beautified with a kind of conical Figures, beginning in more acute, and ending in blunt Cones.

+ ee. The Hemisphæres are parted by a long Fissure +, in which, as in a Trench, a Blood-vessel takes its progress the whole length of the division.

+ ff. The Surface of the Brain is shaded with many Branches of Blood-vessels + sprouting out of the said Trunk, seated in the Fissure, interceding the Hemisphæres.

+ s s s s s s s s. The Hemisphæres of the Brain of this Animal, are beautified with many Prominencies +, adorned with various shapes and sizes.

T. 55. F. 2. The
Head of a
Hare opened:
+ A A.

+ aa. A Hare also as well as a Rabbit hath Two large orbicular protuberancies + adjoynining to the Origins of the Brain.

+ bb. The optick Nerves + creep under the points of the Hemisphæres, and are implanted into the inner Region of the Eyes; under these orbicular Processes do creep the olfactory Nerves + and bend their course toward the Nostrils.

+ c c c c. The Hemisphæres + of the Brain, are dressed with a kind of Pyramidal Figure beginning in Cones, and ending in Bases.

+ d d. The Hemisphæres also of this Animal, are divided by a Fissure + (passing the whole length of the Brain,) in which is seated the Trunk of a Blood-vessel, out of which do sprout many Ramulets + divaricated through the surface of the Brain.

+ ff. The Surface of the Brain is adorned with diverse protuberancies, + some Semicircular, or rather Pyramidal, which are seated in the posterior part of the Brain; other Processes of the Brain + are endued with irregular Figures of different Shapes and Magnitudes.

+ h h. The anterior Processes + of the Brain seem to be adorned with a kind of Pyramidal Figure.

The *Cerebellum* of this Animal hath diverse Apartments, composed of one middle, to which on each side a double lateral adjoyneth.

+ i i. The middle Apartment + somewhat resembleth the Vermiforme Protuberance of a Humane Brain, and is somewhat of an oval Figure, and is dressed with many Processes, passing in transverse positions, somewhat like Parallelograms.

+ k k k k k k k k. The lateral + are seated on each side of the middle Apartment, and are beautified with various Processes of different Figures, some being Pyramidal, others Oval, and a Third Conical, and a Fourth irregular.

C H A P. LXII.

The Brain of Birds.

THE Brain of Birds or Fowls is enwrapped within Two fine Vails, the *Dura* and *Pia mater*, which are curious Textures made up of nervous Filaments, spun by Nature's hand to a great fineness, and running several ways, are so closely conjoined to each other, that they seem to make one entire substance, it being very hard to discover the Interstices of the Fibrils.

The greatest part of the Brain in Birds is placed in the hinder part of the Skull, endued with a large Cavity.

The anterior part of the Brain (being very much less before than the hinder) lieth in Two little Cavities, seated on each side of the *Os triangulare*, and being divided by a Fissure running along the midst of it, beginneth in Two points, adjoyning near the entrance of the Two Perforations, leading into the Beaks of Birds, by which Air is conveyed into the Mammillary Processes, endued with an Oval Figure, and made up of a pulpy substance, like that of the Brain, and somewhat hollow in the middle, and covered with a thick tough Membrane.

And the Air being impelled by Two oblong narrow Cavities like Fissures seated on both sides of the Beak, is thence conveyed down through an oblong chink, made in the middle of the Palate into the Mouth, and thence into the *Aspera Arteria*.

And the Air is also received through the Perforations of the Beak another way into a straight Cavity, leading to the Mammillary Processes, by which the Air is received into the Ventricles lodged near the surface of the Two Hemispheres.

The Brain of Birds as well as Man in its superior Region, is composed of Two Provinces, or Medieties, which are as it were Two Hemispheres, parted from each other by a long *Sinus*, void of any duplicature of the *Dura mater*, making the Falciforme Process.

The surface of the Two Provinces is different from that of Man, as being plain and equal, wholly destitute of any winding *Anfractus*, in whose stead (as I conceive) are substituted many Processes, in whose partitions, as in so many Apartmentss are lodged great variety of Veins and Arteries.

Each Mediety accompanied with a Mammillary Process, or an Oval Protuberance, beginneth in an *Apex*, and endeth in the *Occiput* with a large Butt end, each consisting in diverse Fowls of more or less Processes.

Where the *Sinus* is, if you gently part one side from the other, you may discover in the more inward Recesses of the Brain, Two small Processes, the one springing out of the substance of the Brain, seated under the Ventricle, and the other out of the streaky Membrane covering it. And by the interposition of those Medullary Processes, the Two Provinces of the Brain are so locked together, and fixed below to the *Crura* of the *Medulla oblongata*, that they cannot be severed without the violation of each other, or at least of the *Medulla oblongata*, and Medullary slips.

Birds have no *Corpus callosum*, no *Fornix*, no *Corpora striata*, which I conceive are supplied with a streaky Membrane, interlining each side of the partition

The Coats of the Brain of Birds.

The greatest part of the Brain in them is seated near the posterior part of the Skull. The anterior part of the Brain.

The passage how Air is conveyed into the mouth of Birds.

The Hemisphere of the Brain of Birds.

The Brain of Birds hath no *Anfractus*.

Each Hemisphere hath an adjoining Oval Prominence. Two small Processes in the inward Recesses of the Brain.

The streaky Membrane supplieth the defect of many Processes in the Brain of Birds.

tion interceding the Two Hemispheres ; each of these White Membranes are beautified with variety of streaks, streaming like Rays, from the circumference to the lower Angle, and are concentred about the insertions of the Medullary Processes, which link the Two Provinces together, and being opened with a Knife, a Cavity may be discerned in each Hemisphere, seated under the streaky Membranes, which discharge themselves into one common Channel, leading into the *Infundibulum*.

A Cavity may be seen in each Hemisphere leading into the *Infundibulum*. The principal part of the Brain is Cortical in Birds.

The greatest part of their Brains consisteth (as I apprehend) in a cortical substance, appearing to my Eye upon a near search, of a Cineritious colour, and the *Medulla oblongata*, and the appendant Oval Processes, being of a White colour, make but a small portion of the Brain, if a regard be had to the Cineritious part, of which it is principally made up.

The Brain of Birds is full of Globules.

The Cineritious and White substance of the Brain, are framed of numerous small Globules, and are nothing but contextures made up of various Vessels, Arteries, Veins, and nervous Fibrils (interspersed with a soft pulpy substance) which being cut in the opening of the Brain, I plainly perceived after a short time, the inward Recesses of it to be freely bedewed with a Crystalline Liquor, which I think to be the *Succus nervosus*, distilling out of the wounded Fibrils of the Brain.

The *Succus nervosus* in the Brain of Birds.

The Ventricles of the Brain of Birds.

And the Hemispheres being cut crossways, we may easily discover Two small Cavities (which are instead of the Ventricles) seated in each Hemisphere, near the surface of the upper Region ; but in greater and more perfect Animals, they are placed more toward the Base of the Brain, not far from the upper part of the *Medulla oblongata*, whose Origins are the *Corpora striata*, lodged in the anterior part of their Cavities.

The Four Sinus in the Brain of Birds.

Birds are furnished with Four Sinus. The First being the long Sinus, runneth all along from the anterior to the hinder part of the Brain, and is not so deep in proportion, as is found in other more perfect Animals : from which it differeth, as being destitute of the Falciforme Process, by whose mediation in other greater Animals, they are divided, as by a Wall, from each other.

The lateral Sinus are short Channels, taking their rise where the *Dura Meninx* parteth the *Cerebrum* from the *Cerebellum*.

And the Fourth Sinus is seated somewhat lower in Birds than in other Animals, a little below the *Glandula pinealis*, where this hollow and round Process is let down upon the *Crura* of the *Medulla oblongata*, where it is immediately divided into Two branches, which climb up into a Cavity, seated in the hinder part of the Head, between the streaky Membrane and the Hemispheres.

The Processes accreting to the *Medulla oblongata*.

There is not only a great disparity in the Brain, but also in the *Medulla oblongata* of Birds, from other more perfect Animals ; for near the place (where the optick Nerves borrow their Origin) Two eminent Protuberances do accresce to either side of the *Medulla oblongata*, and are greater proportionably, than those of Men or Brutes ; so that they may seem a Second Brain, contributing aid to the other ; And (as I conceive) these large Processes of the *Medulla oblongata*, are endued with a Cortical substance, in which is seated a small White *Medulla* in the inside, so that not only the Brain, but the Processes are also furnished with Two Chambers or Ventricles : And in the middle of the Medullary Trunk (where the Two Prominences are appendant to both sides) is seated a Fissure, leading to the *Infundibulum* ; and the Ventricles, and the Mammillary Processes have their Apertures, by which the

The Ventricles belonging to the Processes of the Brain in Birds.

the serous Recrements of the Brain are discharged into the chink, as by a common Duct, into the *Infundibulum*.

And it may seem very probable, that these large Prominencies are substituted, in stead of the *Corpus callosum*, deficient in Birds, which have not only protuberancies appendant to the sides of the *Medulla oblongata*, but are beautified also with several Processes lodged in the upper Region of the Brain, which I shall endeavour to illustrate by manifold instances, in describing the Processes of the Brain, relating to various kinds of Birds.

The under Processes of the Brain, are substituted in stead of the *Corpus callosum*. The Processes of Birds.

The Blood-vessels (belonging to the Brain of Birds) are so small, that they hold little or no proportion with those of other Animals; and their Trunks of Veins and Arteries (climbing up through peculiar Perforations within the Skull, without any divarications into the *Plexus Retiformes*) do creep up near the *Glandula pituitaria*, and ascend the Brain in a direct course, dispensing small and fruitful Branches, both to the Surface, and inward Recesses of the Brain; which in Birds, is bedewed with small drops of vital Liquor, and the Brain of other Animals is more freely irrigated with greater streams.

The Blood-vessels of Birds.

The Brain of a Goose much resembleth that of a Bustard, and is composed of Four Processes (appearing in the upper part of the Brain) Two of which are seated in each Mediety.

T 56. F. 1. 2. The Head of a Goose opened.

The outward Processes are very large and long, beginning in small points, and ending in blunt Cones.

+ 44.

The inward Processes are much smaller then the other, and are placed about the middle of the long *Sinus*, and are adorned with a kind of Oval Figure.

+ 45.

The Two Provinces of the Brain being parted a good space toward the Base, may be discerned a number of small Globules, dressed with various shapes and sizes, and seem to resemble a number of Glands, which I conceive, to be so many systems of Vessels, made up of Arteries, Veins, and nervous Fibrils.

Near the Base of the Brain, is seated on each side, an Oval Prominency somewhat resembling in Figure the Nativiforme Processes of a Humane Brain; and are like in colour and substance to the *Medulla oblongata*, to which they are appendant as its Processes.

F. 2. The Head of a Swan opened.

The Brain of a Swan is composed of Six Processes, the Two anterior + are adorned with a kind of Oval Figure.

+ 46.

The Posterior Processes + are endued with a semi-circular shape, and have their points below, joyned to each side of the *Cerebellum*.

+ 47.

The Interior Processes are also Two in number, of a Pyramidal Figure, and joyn in their Apices, or points above, to the Oval Processes, and do terminate in their Bases below to the points of the semi-circular.

+ 48.

In the middle of the Brain, is seated a Falciforme Process, running all along from the Anterior to the Posterior part of the *Cerebellum* +

+ 49.

The olfactory Nerves + seem to take their rise under the Second pair of Processes, and passing on the sides of the orbicular Processes, do afterward encircle the *Os Spongiosum*, and terminate into many Filaments + (the Organ of Smelling) about the Perforations, placed not far from the middle of the Beak +.

+ 50.

+ 51.

+ 52.

The

F. 3. The
Head of a
Mallard open-
ed.

+ a a.
+ b.
+ c.

+ d d.

+ e e.

+ f f f f.

F. 4. The
lower Region
of the Brain
of a Mallard.

+ a a.

+ b.

+ c c.

+ d d.

+ e.

+ f f.

+ g g.

F. 5. The
Head of a
Bird (called
a Shuffler)
opened.

+ a a.

+ b b.

+ c c.

+ d d.

+ e e.

+ f.

+ g g.

T. 57. F. 1.
The Head of a
Bustard open-
ed.

+ A A.

+ a a.

+ b b.

+ c c.

F. 1. D D.

The olfactory Nerves + creep under the Apices of the Hemisphæres, and pass over the optick Nerves, and then encircle the *Os spongiosum* as + with Two Arches; and afterward closely approach each other for some time, and at last terminate into many Filaments + near the Extremity of the upper Beak.

The optick Nerves + seem to come out of the *Medulla oblongata*, and Origens of the Hemisphæres, and creep under the olfactory Nerves, and then are implanted into the inner Region of the Eyes.

The Hemisphæres of the Brain + being divested of the *Dura* and *Pia Meninx*, the Brain may be discovered to be made up of many little Globules +, which are Systems of several minute vessels.

In the lower Region of the Brain of a Mallard the Nerves may be more clearly discovered, and the Auditory + sprouting out of the *Medulla oblongata*, and passing under the olfactory Nerves, are also derived from the said *Medulla*, and encompass the *Os spongiosum* + tending toward the Extremity of the Bill.

The optick Nerves + do proceed more highly out of the *Medulla oblongata*, and make their Egress near the Apices of the Hemisphæres + and afterward intersect each other + and then pass obliquely toward the Orbs of the Eyes.

The Hemisphæres + of the Brain are parted in the midst by a Fissure + and are beautified with a kind of Oval Figure.

The Bird (called a Shuffler) much resembleth a Mallard in Figure, and its Brain hath a great likeness in Colour, Substance, and Shape, in reference to its Hemisphæres + (parted by a Fissure +) adorned with a kind of Oval shape.

The olfactory Nerves + come out of the Brain about the Origens of the Hemisphæres, and encircle the *Os spongiosum* as with Two Arches, and then closely associate each other, and after a small space have Branches of Nerves + arising out of the Trunk of the olfactory Nerves, and terminate near the Perforation of the Bill + and afterward the Trunks make their progress on each side the Intersepiment + of the Bill, and end near its extremity into numerous Filaments +.

A Bustard being a Bird of high esteem, as having a Body as good in quality as great in bulk, is endowed with a Brain (of small dimensions) which consisteth of Two Hemisphæres (parted from each other by a long Fissure or *Sinus* +, which are much larger in their Posterior Regions, or Butt ends, and begin in narrow points, or Apices near the Beak.

The great part of the Brain is framed of Two large Processes (which make the Hemisphæres of the Brain) each of them beginneth in points + placed near the Eyes, and terminate into round protuberancies +.

The *Cerebellum* is accompanied on each side with an oval Process +, whose acute points confine on the *Cerebellum*, and their blunt Cones run under the sides of the Brain, tending forward.

The *Cerebellum* is seated on the posterior part of the Brain, and insinuates it self a good space between the Two blunt Cones of each Hemisphære, and is fastened to the inside of them, not far distant from the middle.

This *Cerebellum* hath no Vermiforme Process, but many *Lamellæ* +, resembling a kind of Parallelograms, and differ only as they are somewhat rounded

rounded in their terminations; these oblong Processes have some obscure partitions, in which the Blood-vessels are allodged; and upon this account these Processes of the *Cerebellum*, have analogy with the *Anfractus* of the Brain (relating to other more perfect Animals,) as they are Repositories of Arteries and Veins.

+ cc.

The beginning of the *Medulla Spinalis* + is parted in the middle into equal parts, and so continues the whole length of the Spine.

+ F. 1. ffff.

The olfactory Nerves + are derived from Two Prominencies, adjoining to the anterior part of the *Medulla oblongata*, and climbing upward, creep out of the Brain, near the Apices of the Hemispheres, and are conjoined for some space, and afterward part encircling the *Os spongiosum* +, and then unite again; and after a little space, are emitted out of the Caudex of the conjoined Nerves, (to a Branch resembling a kind of Arch +) which terminate into many minute Fibrils, seated about the two oblong *Foramina* perforating the upper Beak, the immediate Organ of Smelling.

+ F. 1. gg.

+ F. 1. bb.

+ iii.

Both Provinces of the Brain of a Bustard being opened and turned on each side, the greatest part appeareth Cortical, endued with an ash-coloured substance, made up of numerous small Globules + (of various sizes) enamelled with many minute branches of Arteries and Veins, interspersed with very small nervous Fibrils, as being the most proper compage of the Brain.

F. 2. The Brain of a Bustard opened.

+ a a a a.

Under the Two Hemispheres, on the upper Region of the *Medulla oblongata*, are seated Two Oval Processes, with oblong Necks +, which are united near the anterior part of the Brain; and Two other Processes + are placed on the posterior part of the former oval Prominencies) which are less, and endued also with an oval Figure, and are united by a narrow oblong Medullary substance +. And are lodged in some part near the anterior Region of the *Cerebellum*, which is endued with a White Process, fastning it to the *Medulla oblongata*.

+ bb.

+ cc.

+ dd.

The Brain of a Turkey being stripped of its Coats and laid open, seemeth to consist of many Globules + of different Magnitudes, and many of them are endued with an orbicular Figure; and are framed of a Cortical and Medullary substance.

F. 3. The Brain of a Turkey opened.

+ F. 3. a a a a.

The Mammillary Processes + are dressed with a kind of triangular Figure, and are seated near the Origin of the Brain, and have a pair of olfactory Nerves + creeping under them out of the Brain into the Membrane, lining the Nostrils.

+ bb.

+ cc.

About the termination of the Brain, are lodged Two Medullary Processes, beautified with an Oval Figure (somewhat resembling the Natisforme Processes) and are tied together by the interposition of an oblong Medullary Process +.

+ d.

+ ee.

The *Cerebellum* beginneth and endeth in blunt Cones + and is adorned with oblong Processes + running cross-ways, somewhat resembling *Lamellæ*.

+ ffff.

The Medullary part of the Brain of a Turkey seemeth to be full of streaks, which are nervous Fibrils, and many small Prominencies, which are Bodies aggregated of variety of Vessels.

F. 4. The Brain of a Turkey taken out of the Skull and opened.

+ a a.

Near the hinder part of the Brain is seated the Origin of the *Medulla Spinalis* + which is nothing else but the elongation of the *Medulla oblongata*.

F. 5. The Cerebellum of a Turkey taken out of the Skull and Dissected.

† F. 5. a a a a.

The *Cerebellum* of a Turkey parted from the Brain, and taken out of the Skull, when it is variously opened with a Knife, it giveth a fine prospect of many Ramifications, resembling the Branches of Trees †, which are numerous Medullary Processes, furnished with variety of Vessels.

F. 6. The Head of a Woodcock opened.

† F. 6. a a.

Each Hemisphere relating to the Brain of a Woodcock, may (if inspected with a curious Eye) be seen to be composed of Three Processes, the Anterior † is larger then both the other, and begins in a point, and endeth in much larger dimensions.

† b b.

The middle Process † is adorned with a kind of triangular Figure, having its Base outwardly, and its point toward the more inward part of the Brain.

† c c.

The Posterior Process † of each Hemisphere is endued with an irregular shape, and beginneth more narrow, and endeth more dilated in the hinder part of the Brain, adjoyning to the Natiform Processes.

† d d.

Near the hinder Region of the Brain are situated Two Processes † endued with a kind of Semi-circular Figure, beginning and ending in Cones, and in one Extremity, adjoin to each side of the *Cerebellum* near its Origen.

† e e e c.

The *Cerebellum* of this Bird is beautified with many transverse lines, as being numerous *Lamellæ* †, the various allodgments of Vessels, and another line † passeth the whole length of the *Lamellæ*, almost from the top to the bottom.

† f f.

† g g.

The olfactory Nerves † do seem to spring out of the points of the Anterior Processes, and after a little space do encompass with Arches the *Os spongiosum*, and afterward unite again, and make their progress the whole length of the Bill.

F. 7. The Head of a Teal opened.

† a a.

The Brain of a Teal is made up of Six Processes, as each Hemisphere is graced with Three Processes, the Two Anterior † are beautified with a kind of oval Figure, beginning in acute, and ending in more obtuse Cones.

† b b.

The lateral Processes † have a triangular Figure, and do enclose within their Angles the inferior Processes, which are adorned with an oval Figure, beginning in small Extremities, and end into more blunt round Heads, adjoyning to the Origen of the *Cerebellum*.

† c c.

† d d.

The *Cerebellum* † in this Bird seemeth to be double, as consisting of Two Natiform Processes, on which do confine Two orbicular Processes † seated on each side of the *Cerebellum*.

F. 8. The Head of a Jack Snipe opened.

† F. 8. a a.

A Snipe, in reference to its Brain, is adorned with Four Processes, the anterior † are very small (endued with an oblong Figure) adjoyning to the Apices of the Brain.

† b b.

The other Processes are very large †, taking their rise in small Extremities, and have much greater Terminations.

† c c.

Near the hinder Region Two other Processes † may be discerned, which lean upon the *Cerebellum*, and are dressed with a kind of oval Figure.

† d d.

† e e e e.

The *Cerebellum* † is enamelled with many Red lines running cross-ways, and have Two other lines † intersecting the former, and passing down the whole length of the *Cerebellum*.

T. 58. F. 1. The Head of a Curlew opened.

† a a.

The Head of a Curlew being opened, we may take the prospect of its Brain, beautified with Two Hemispheres † divided by a long Fissure.

These

These Two Provinces of the Brain have their Apices, adjoyning above to the olfactory Nerves, and their Terminations leaning upon Two Processes, somewhat like the Testiform Protuberances of the Brain.

The Hemisphæres are enamelled with variety of Blood-vessels †, diva- † b b b b. ricated through the *Dura* and *Pia mater*, the fine vails of the Brain.

The Hemisphæres are rendred uneven by many Risings † of different Fi- † c c c c c c. gures and Magnitudes, in which they seem to resemble various Processes.

Between the Termination of the Hemisphæres, and the Origen of the *Cerebellum*, are seated Two oblong narrow Processes † of a semi-circular Fi- † d d. gure) not unlike the Testiform Prominences of the Brain.

The *Cerebellum* † hath many transverse Processes, somewhat like Parallelo- † c c c c c. grams, and is adorned with a kind of an inverted Pyramidal Figure, as the Base being turned upward, and the Cone downward.

A Godwitt being highly esteemed for its delicacy of Flesh, hath a Brain beautified with Two Hemisphæres † parted by a long Fissure, dressed with oval Figures, having their greater Extremities † leaning upon the *Cerebel- † b b. lum* † and its adjacent Processes, and its lesser upon the olfactory Nerves. † c c.

The upper surface of the Brain is rendred unequal by many unevennes- † sses † seeming to resemble Processes of diverse Figures, some Pyramidal, or † d d d d d d. Quadrangular, others Irregular and difficult to be described.

About the Origins of the Brain are placed Two small Processes †, (en- † e e. dued with a kind of orbicular Figure) somewhat like Glands.

The olfactory Nerves †, go first in straight lines, and then pass af- † f f. ter the manner of Arches †, encircling the *Os spongiosum*, and afterward make † g g. their progress in a direct course the whole length of the Beak.

The *Cerebellum* of this Bird is composed of Three Apartments, one being seated in the middle, and One on each side of the greatest Province.

The middle Apartment † is the largest of all, and begins in a great rounded † b b b b. Head, and terminates in smaller dimensions, and is beautified with many long and shorter Processes † (going in parallel lines) somewhat resem- † i i. bling Parallelograms in Figure.

The lateral Apartments of the *Cerebellum*, seem to be Two small Proces- † ses † (endued with a semilunary Figure) encircling the sides of the up- † k k. per part of the middle Apartment.

On the Convex part of these semilunary Processes do confine Two other somewhat larger Processes † which are also adjacent to the Terminations † l l. of the Hemisphæres, and are endued with different Figures, the one being oval, and the other triangular.

The Head of a Virginia Nightingale hath not only its Brain encircled with Two Membranes, but also with Two Skulls too, as with more thick Walls, the upper is made of Two *Laminae*, interlined with a spongy substance, and the lower Skull is thinner then the other (all beset with fine Down) immediately encompassing the *Dura mater*.

The Head being opened, the Brain may be discovered to be composed of Two Hemisphæres †, graced with a pyramidal Figure, the Bases being the † a a. Terminations and the Cones, the Origins of the Brain.

One of the Hemisphæres, being invested with its Coats, seemeth to be adorned with Three Processes, the First being anterior † is endued with a † b. pyramidal Figure, and exceedeth the other in dimensions;

T. 58. F. 2.
The Head of a
Godwitt
opened.

† a a a a.
† b b.
† c c.

T. 58. F. 3.
The Head of
a Virginia-
Nightingale
opened.

† a a.
† b.

The Second may be called lateral †, and seemeth to be dressed with a pyramidal Figure, and is crooked, and somewhat semi-circular.

The Third being seated in the termination of the Hemisphæres, may be named Posterior, and is less then the other, and is adorned with a kind of semilunary shape.

The other Hemisphære being divested of its Coats, and scraped in its upper surface, doth present the Spectator with a pleasant sight of many Globules, resembling Glands.

The *Cerebellum* of this Bird is beautified with an Oval Figure † The smaller Extremity insinuates it self between the terminations of the Hemisphæres, and the greater end is encircled with a semi-circular Process, which I conceive is part of the *Cerebellum*.

On each side of the *Cerebellum* is contiguous a semilunary Process † enclosing the terminations of the Hemisphæres.

About the termination of the *Cerebellum* is placed another Process † divided into many partitions, and is embellished with a semilunary shape.

The Brain of a Partridge in its outward surface, is dressed with many Prominencies †, (endued with different Figures and Magnitudes) and is made up of Two Hemisphæres †, adorned with a pyramidal Figure, beginning in Cones and ending into Bases, seated in the posterior part of the Brain.

The Hemisphæres in this Bird (as well as in others) are divided from each other in their ambient parts by a Fissure †.

The olfactory Nerves † are derived from the *Medulla oblongata*, and do seem to make their egress out of the Brain, under the Apices of the Hemisphæres.

The *Cerebellum* † hath its dimensions more enlarged toward the Brain, and more contracted toward the *Medulla Spinalis*, and is beautified with many semi-circular narrow Processes †, making their progress obliquely cross-ways on each side of the *Cerebellum*; near its Origen is seated a small Process †, adorned with an oblong oval Figure: Below the *Cerebellum* may be discerned the *Medulla Spinalis* †, divided into equal parts by a Fissure.

The Brain of a Pidgeon is composed of Two Hemisphæres † which seem to be adorned with a pyramidal, or rather oval Figure, and are parted by the interposition of a Fissure † (running the length of the Brain) in which is lodged the Falciform Process, being a Duplicature of the *Dura Meninx* in Birds as well as other Animals, and taketh its rise about the points of the Hemisphæres, and passeth all the Fissure, and at last encircles their Terminations, as with Two Arches †.

The olfactory Nerves † take their origination out of the *Medulla oblongata*, and seem to creep under the Origers of the Hemisphæres.

The *Cerebellum* † is endued with a kind of oval Figure, and is dressed with many narrow oblique Processes †, passing cross-ways.

To each side of the *Cerebellum* is adjacent a small protuberance †, beautified with an oval shape.

The Brain of a Kings-Fisher seemeth to be beautified with diverse Prominencies of different shapes and sizes, and some of them seem to be pyramidal.

The Hemisphæres † in this Bird as well as others, begin in points, and end in more enlarged dimensions.

The

† a.

† c.c.

† f.f.

F. 4. The
Head of a Par-
tridge open-
ed.

† a a a a.

† b b.

† c.c.

† d d.

† e.

† f.f.

† g g.

† h h.

F. 5. The
Head of a
Pidgeon
opened.

† a a.

† b b.

† c.c.

† d d.

† e.

† f.f.

† g g.

F. 2. The
Head of a
Kings-Fisher
opened.

† a a.

The olfactory Nerves seem to be double, the more outward † take their † *bb.*
Origen from the sides of the *Medulla oblongata*, and creep under the Brain, a
little space from its Origination.

The inward olfactory Nerves † borrow their rise from the *Medulla ob-* † *cc.*
longata, and creep under the Origins of the Hemisphæres, and pass along to-
ward the Beak.

The *Cerebellum* † in this Bird is endued with a kind of inverted pyrami- † *d.*
dal Figure, by reason its Base is upward, and its Cone downward.

This Figure of a Goose is much different from the former, in which
the Brain of the Goose is divested of its Coats, and appeareth to be a Sy-
steme of many Globules † (besetting each Hemisphære) composed of se-
veral kinds of Vessels, so that they have much affinity with Glands, as
being strainers of the Blood, whereby the albuminous part of the Blood is
separated from the Red Crassament, in order to the preparation of the ner-
vous Liquor.

The Hemisphæres † begin in Apices or Points, and end in much greater † *bb.*
rounded Heads, and between passeth a Figure †, separating the Hemisphæres † *cc.*
from each other.

Beyond the Apices of the Hemisphæres, is seated the *Os spongiosum* †, † *d.*
adorned with a Conical Figure.

The optick Nerves † take their rise near the Origen of the *Medulla oblon-* † *cc.*
gata, and are inserted into the inward Region of the Eyes.

The olfactory Nerves † sprout out of the sides of the *Medulla oblongata*, † *ff.*
and afterward pass over the optick Nerves, and encircle the *Os spongiosum*
with Arches, and then associate, and out of their Trunks arise on each side
a Branch †, and terminate near the perforation of the Bill. † *gg.*

These Trunks of olfactory Nervts end in Two round protuberancies †, † *bb.*
out of which do arise many nervous Fibres † terminating near the Extre- † *ii.*
mity of the Bill.

Near the posterior Region of the Brain, is seated the *Cerebellum* †, adorn- † *kk.*
ed with an oval Figure, and beset with many oblong narrow Proccesses, some-
what like Parallelograms in shape.

T. P. 2.
The Head of
a Goose open-
ed.
+ *aa.*

C H A P. LXIII.

The Brain of Fish.

The Processes
of the Brain
of Fish, are
akin to those
of a Humane
Brain.

THE Brains of a Fish are composed of divers little Prominencies, somewhat resembling the minute Processes of a Humane Brain, the *Glandula pinealis*, and the Natiform and Testiform protuberancies, and the *Corpora striata*; all which different Prominencies of Mans Brain, and the various small Processes of Fish, are like in some sort, both in Colour, Figure, and Substance; and are also, as well as those humane Processes, appendant to the *Medulla oblongata*, which in Fish is garnished above and below, with great variety of little Prominencies.

Whereupon many considerables do offer themselves to our notice: The first production of the Brain of Fish, and the causes of the determinate shapes and sizes of it; And the substance founded in diverse parts, of which the Brain of Fish is composed; as also the disproportion and analogy it holdeth with that of a Humane Brain, and the variety of Brains of Fish, wherein every Brain differeth from it self, as well as the Brains of others, in reference to its Processes, adorned with diverse Figures and Magnitudes, which to clear up, it will not be impertinent to give a description of the Brains of various Fish, with some remarks upon them.

The first For-
mation of the
Brain of Fish.

As to the First production of the Brain of Fish and other Animals, I conceive it is derived from saline Particles, accompanied with a fluid viscid Matter, easily concreted, so that the seminal juyce, out of which the Brain of Fish is generated, is primarily a fluid transparent Liquor, which afterward growing more solid, loseth its transparency, when it is coagulated by saline parts, in which the plastick virtue is chiefly founded, by whose mediation the loose Texture of the first rudiment of the Brain is consolidated into a firm Cortical and Medullary substance (every where interspersed with variety of Tubes and Fibres) which in the Brain of Fish do not constitute one entire uniform Body, but many, some time irregular, and other times regular minute Prominencies, set off in great variety of Geometrical Figures and Magnitudes, which take their first conception and birth from the greater and less proportion of seminal Liquor, impregnated with several Salts, which are the cause of the manifold figuration of the distinct Processes; because different Animal Salts, as well as Mineral, do shoot their diverse parts of Seminal Liquor, into great variety of curious shapes and sizes.

The Processes
of the Brain
of Fish is
sometimes
regular, other
times irregu-
lar.

The cause of
the different
Figure of the
Processes.

The end of
the different
Figures of the
Brain of Fish.

And I humbly conceive that the end of the Figures of various protuberancies of the Brain of Fish, may be deduced from hence, That they being chiefly orbicular or oval, are most capacious, as receptive of the greater number of Globules, resembling Glands, as being Systems of several kinds of Vessels; and if the Processes be endued with many Angles, they are instituted by Nature to fill up the spaces, interceding the neighbouring Prominencies, which is contrived with great Artifice, to contain much in little.

The substance
of the Brain
of Animals,
is framed of
many Globu-
les.

The substance of Fish, Fowls, and other Animals, is framed of a number of Globules, as so many minute Bodies of various Figures and Magnitudes, so curiously conjoynd one within another, by the interposition of thin Membranes, that they seem to constitute one entire Fabrick.

These

These Globules (as I guess) are collective Bodies, consisting principally of nervous Fibrils, and some Arteries and Veins, and perhaps Lymphæducts (which will be worthy a curious search) because it may not be altogether unreasonable to imagine, where so many nervous Filaments are seated, they may be accompanied with Lymphæducts in the Brain, as well as in other parts of the Body.

The nature of these Globules.

These various Globules, being (as I conceive) a great company of greater and less Tubes, and Fibres, framed in a kind of greater or less Arches, one seated under another in a beautiful order, the greater being placed near their ambient parts, and grow less as they approach the inward Recesses of the Processes, and in their Colour and Figure, much resemble Glands, and may truly deserve this appellation, as being consigned to the same use with them; to percolate the Liquors of the Brain, and render it fit for the generation of Animal Juyce, which may be produced after this manner.

The Globules of the Brains of Fish are much alike to Glands.

The *Succus nutritius* being in association with the vital Liquor, when it is transmitted into the body of these cortical Globules, the purer part being secreted, and impregnated with volatil Salt, is afterward received into the Origins of the nervous Fibrils, and so by degrees conveyed through all the Processes of the Brain.

The Brains of Fish may claim our consideration, as they declare the great Power and Wisdom of the Almighty Architect, in reference to the difference they have from, and the Analogy with Humane Brain, in which they correspond in the Coats of the *Dura* and *Pia Meninx*, investing the Processes of the Brain; and in the Cineritious, and White Medullary substance of it; and in the partitions between the Processes, which are substituted instead of *Anfractus*, as so many allodgments of Vessels; and some Fish, as a Skait, Thornback, and Flaire, have a sort of *Anfractus* seated on the sides of the posterior Processes. And the Humane *Medulla oblongata*, and *Spinalis*, have some semblance with those of Fish in point of Figure, and have a division all along the middle of them, so that they appear to be Two *Medulla oblongata*, and Two *Spinales* clapped together, and some do seem to be one entire Body without any seam in the midst; but others to be composed of many minute Processes, out of whose sides do spring a great number of Nerves, made up of diverse Filaments, (closely united by thin Fibres) investing a pulpy substance, the same with that of the Brain; the Nerves being so many elongations of it, as consisting of diverse Coats, encircling a Medullary Body.

The Analogy of the Brain of Fish with that of Man.

The partitions interceding the Processes, supply the defect of *Anfractus*.

The division of the *Medulla oblongata*, and *Spinalis*.

The Nerves of Fish do sprout out of the numerous Processes of the *Medulla oblongata*.

The Brain of a Dog-Fish (called *Canis Cacharius* in Latine) is very remarkable, as being a clammy glutinous Matter, very transparent, in which I discerned the optick and motory Nerves relating to the Eyes; as also the olfactory, and other pairs of Nerves belonging to Muscles; endued with a soft White substance, swimming in a viscid Liquor, which was all the Brain I could discover in this voracious Fish; and among the Fish I have Dissected, (which have been very numerous) I never met with a Brain wholly liquid, as not at all coagulated into any Processes; The Brain of a Carp and Bream, being composed of many Protuberancies (beautified with diverse shapes) is encircled with a transparent Matter, resembling the Lytharge of Gold; but the Brain of this kind of Dog-Fish (which I apprehend to be a Sharke) is wholly of a viscid nature, of which the more ambient parts are hued with an Ash-colour, and the more inward Recesses are adorned with bright transparent

The Brain of a Dog-Fish is made of a viscid transparent Liquor.

The Nerves do seem to swim in this Liquor.

The transparent Matter encircling the Brain of a Carp and Bream, &c. The colour of this Liquor.

rent colour (from which, as from the *Medulla oblongata* in other Fish) the Trunks, relating to the Brain, do borrow their origination.

The nervous
Liquor in the
Brain of this
Fish.

Out of the more refined and thin parts of this transparent Liquor, the *Succus nervosus* is extracted (impregnated with volatil, saline, and spirituous Particles) and transmitted into the extremities of the Nerves (to render them tense and vigorous) which I saw seated in the more bright, thin, and transparent part of this Liquor not far from the Palate, which was divided from it by the interposition of a thick, tough, white Membrane.

Nature sporteth her self in variety of Processes, different in Magnitudes, Figures, and Number.

Three Protu-
berancies in
the Brain of a
Mackerel.
Five Processes
in the Brain of
another.

In the Brain of one Mackerel I discovered only Two or Three Protuberancies, all endued with an oval Figure.

In another (which I Dissected) I found Five Processes, the Two Anterior, and least, were orbicular, the middle were larger, and of an oval Figure, and the Fifth and Posterior, being the *Cerebellum*, was beautified with a Pyramidal shape.

Seven Proces-
ses in the
Brain of a
Third.

In the Third I found Seven Processes, the First pair were small and conical, the Second oval, the Third were endued with a triangular Figure; and the Posterior Process, or *Cerebellum*, with an oval shape.

Nine Promi-
nencies in the
Brain of a
Fourth.

In the Fourth I saw Nine Processes, the First were minute and orbicular, and the Second were a little larger, and oval; the Third rise in Dimensions, and are also oval; the Fourth are yet larger, and triangular, and the Ninth is the largest and oval.

Five Protube-
rancies in the
upper Regi-
on, and most
oval, and
many minute
orbicular in
the lowest
part of the
Brain in a
Fifth.
Four Promi-
nencies in a
Sixth.

In the Fifth I found Five Protuberancies in the upper region of the Brain, most of them being oval, and the Posterior of a triangular Figure; in the middle and lower region I found many small orbicular Prominencies (I conceive) Twenty in number, resembling so many minute Glands, which were composed for the most part of a cineritious substance, and had their most inward Pentrals endued with a White Medullary substance.

In the Sixth I discerned only in the upper Region of the Brain, Four large Protuberancies, one pair being of a triangular Figure, was attended with Two small pair of oval Processes, in the middle were seated a pair of a quadrangular Figure; and the Posterior being the *Cerebellum*, was endued with a flat oval shape; in the lower Region were lodged many minute orbicular, or oval Processes.

The Brain of
the Ninth was
endued with
Nine Protu-
berancies of
different sizes
and shapes.

In the Seventh I saw in the upper Region Four pair and an odd Protuberance seated in the Posterior Region.

The Two First pair were very small, and of an orbicular Figure. The Third and Fourth pair were larger, and of a triangular Figure; and the Posterior Prominence was endued with a pyramidal shape. In the lower Region I discovered a company of orbicular Processes, resembling a bunch of Grapes.

In the Eighth
I found Seven
or Eight Pro-
cesses in the
Brain.

In the Eighth, I discerned in the upper Region, Seven or Eight Processes of different Figures and Magnitudes, seated in irregular positions; and in the lower Region I saw a great store of small orbicular Processes tied to each other by Ligaments; and all these Protuberancies lodged in the upper and lower Region, are outwardly hued with an Ash-colour, and inwardly with White, their ambient parts being of a Cortical, and their more inward of a Medullary substance.

The more
outward part
of the Pro-
cesses of the
Brain of Fish
are Cortical,
and the more
inward Me-
dullary.

And now some curious person may demand to what end the many Processes of this and other Fish are consigned; to which I make bold to give this reply; That the first use may be to strengthen the tender Compage of the Brain,

Brain, which if it consisted in one entire substance, would be easily disordered, as attended with lacerations of the minute Vessels easily produced were they not walled in with many Coats, encircling various small Protuberancies of the Brain of Fish.

The First use of the Processes of the Brain of Fish.

Another use of the several Processes of the Brain of Fish may be this, that they being, as it were, so many distinct Brains; when one is wounded or compressed, the other may truly exert their operations, as being parted from it by proper Membranes; so that the motion of the vital or nervous Liquor being intercepted in the Blood-vessels, or carnos Fibres of one disordered Process, it may have its free course in the other.

The Second use of the Processes of the Brain.

The upper Region of the Brain of a Thornback being of a cineritious Colour, is for the most part a System of many cortical Glands, which are lodged upon, and affixed by large parts to the *Medulla oblongata*, of a White pulpy substance, whose Anterior part is broad, and of a triangular Figure, the point inclining toward the Origen of the Brain, and its Base toward the beginning of the *Medulla Spinalis*.

The upper Region of the Brain of a Thornback.

The Posterior part of the Brain being the *Medulla oblongata*, is little different from the *Spinalis* in Colour and Magnitude; the latter being a continuation of the former.

The *Medulla Spinalis* is an elongation of the *Medulla oblongata*.

The Olfactory Nerves, are derived from the anterior Processes, which consist in a Cortical, or Cineritious, or a White, or Medullary part.

The rise of the olfactory Nerves.

The cortical Glands are Systems of numerous vessels of Arteries, Veins, and especially Fibres, which being united, do make Trunks of Nerves, springing out of each side of the *Medulla oblongata* and *Spinalis*, to the olfactory Nerves, which sprout out of the Anterior Processes, or Origen of the Brain, and take their course toward the Mouth, and end in numerous ranks of Fibrils (the Organ of Smelling) lodged in Two Cavities and Repositories.

The substance of the Cortical Glands.

The Second pair of Nerves, (denominated Opticks) come out of the beginning of the *Medulla oblongata*, and pass obliquely cross-ways toward the inside of the Eyes.

The olfactory Nerves in this Fish end in numerous Fibrils.

The motory Nerves relating to the Eyes are double, and insert themselves into the various Muscles.

The motory Nerves of the Eyes.

On each side of the *Medulla Spinalis* do sprout out numerous Nerves, which are implanted into the Muscles of the Face and Body.

The Nerves of the *Medulla Spinalis*.

The various Processes of the Brain for the most part being of an Ash-colour, are Compages of nervous Fibrils, so that every Process seemeth to be a distinct small Brain, having peculiar Coats, made up of fruitful Glands, consisting of various Blood-vessels, but especially of numerous Fibrils, the Origins of Nerves.

Every Process seemeth to be a distinct Brain, as encircled with a proper Membrane.

Beyond the transverse Processes in a Fire-flaire, is lodged the *Medulla oblongata*, which is thin, and halfe an Inch broad, of a depressed round Figure, endeth into Two oval Processes, and is seated in the Base of the Brain; to the upper Region of the *Medulla oblongata*, are appendant many Cortical small Processes tied to it, and to each other with thin membranous Filaments.

The *Medulla oblongata* of a Fire-flaire.

The *Medulla oblongata* in a Skait is also joyned in its fore Region, to the large transverse Process, and passeth under the Cortical Protuberancies, the space of an Inch in one entire Body, and then divideth into Two Branches, running obliquely towards the insides of the Skull, to which they are affixed, and at last are united, terminating into the Origen of the *Medulla Spinalis*.

The *Medulla oblongata* of a Skait.

The Medulla oblongata of a Cod.

The Natiform Process in the Brain of a Cod. Orbicular Processes.

The orbicular Processes of the Medulla oblongata. The upper Region of the Medulla oblongata of a Pike. The Medulla oblongata of a Bale.

The *Medulla oblongata* in a Cod is much akin to that of the Fireflaire and Skait, in substance and colour, and is an oblong depressed round Body, seated in the lower Region of the Brain, near the Base of the Skull. Not far from the middle of the *Medulla oblongata* are lodged Two oval Processes, which may be styled Testiformes, much resembling the Testicles; and beyond those are seated Two orbicular Protuberancies, confining on the *Medulla Spinalis*; In the middle of these round Prominencies runneth a long Fissure upon the *Medulla oblongata*, parting these Processes in the middle; so that the *Medulla oblongata* of a Cod hath many greater and smaller Processes growing to it.

The upper Region of the *Medulla oblongata* in a Pike, is enwrapped in diverse cortical Processes, much resembling so many small Glands.

The *Medulla oblongata* in a Bale, being of a more solid substance then that of the Cortex, is of a roundish oblong Figure, and seemeth to be one entire Body, but is composed of many small Globules, distinguished from each other by the interposition of distinct Membranes, every Process or Globule being encircled with a peculiar Coat.

And now some Person may think, and not without reason, that I have put my self to a greater expense and trouble then are requisite, in giving a History of so many Brains; which I have done to shew a fine prospect of the wondrous Works of Nature, declared in the variety of Processes (in reference to the Brain of several Fish) as adorned with different shapes, sizes, Figures, numbers, and situations, which speak the infinite Power and Wisdom of the Great Protoplast.

T. 60. F. 1. The Head of a Dog-Fish opened.

Under the Skull of a Dog-Fish (called *Galæus Lævis*) may be seen Three sorts of clammy Liquor, the First is lodged immediately under the Skull, being thick and highly viscid; The Second is a Cristalline Humor, seated in the middle; And the Third Liquor is most glutinous gross Matter, immediately covering the Coats of the *Cerebrum*, *Cerebellum*, and *Medulla Spinalis*.

† a.

The Brain of this Fish is very remarkable, and very different from that of other Fish, as being made of Three Apartments, or large Processes, which are made of diverse parts, the middle is adorned with a Semilunary Figure †, whose Convex surface is set upward, and the Concave below, encircling the upper Region of the middle Province of the Brain; to the horns of the Semilunary Prominence, are affixed Two other Processes; (which resemble Legs) to which are appended Two Processes, not unlike Feet. These parts, (I conceive) are the *Thalami nervorum opticorum*.

† b b.

The middle story of the Brain † is very prominent, and somewhat resembleth in plumpness, the Breast of a fat Child; its Convex part is received into the Concave bosom of the upper Province, and is the Medullary substance of the Brain.

† c c.

The Third Province of the Brain is made of Two Processes (much less then the other) and each of them is beautified with a Semilunary Figure; these Processes are instituted by Nature (as I apprehend) to supply the place of Natiform Processes.

† c c.

The *Cerebellum* is composed of diverse ranks of Processes, a middle, and Two lateral ones; The middle † is made up of many greater and less Semilunary Processes, enclosed above in the Concave Surface of the Testiform

Testiform or Natiform Processes, and below with the inward row of lateral small Processes †, which are again immured on each side with greater Processes †, graced with an oval Figure. † d d. † e e. † f f f f.

The optick Nerves † derived from the sides of the *Medulla oblongata*, and passing proper Perforations of the Skull, are inserted into the inside of Eyes.

On each side of the beginning of the *Medulla Spinalis*, proceedeth a Nerve † covered with a Black Tunicle, and passing all along the outside of the Skull, over the upper part of the Eye, (after an Inch,) is inserted with many Fibrils † into the upper Mandible, and assisteth its Muscles in their Contraction, by which it is lifted up. † g g g g g g g g. † h h.

The Brain of a Skait being taken out of the Skull, a *Bel visto*, appears, composed of many ranks of Processes, to which are appendant (as outlets) the optick and olfactory Nerves.

The Brain and *Cerebellum* is framed of Five rows of Protuberances, the First is made of Four Processes, Two lateral, and Two interior; the outward † are Graced with a kind of pyramidal Figure, the Bases adjoining to the middle Processes, and the Cones to the olfactory Nerves. † a a.

The middle pair † are greater and longer then the lateral, and somewhat resemble Parallelograms. † b b.

The Second row † are endued with an oval Figure, and are much less then the First †. † c c.

The Third rank † are after a manner adorned with a pyramidal shape. † d d.

The Fourth row † are somewhat of a triangular Figure. † e e.

The Fifth row † make the *Cerebellum*, and have an oblong irregular Figure, as well as the rest of the Processes. † f f.

And each side of the Processes of the *Cerebellum* is encircled with Processes of irregular shapes, not unlike Intestines, and somewhat resembling the *Anfractus* of a Humane Brain.

Beyond the *Cerebellum* appears the *Medulla Spinalis* † divided into Two equal parts by the interposition of a small Fissure † and each side of the *Medulla Spinalis* is garnished with numerous Nerves † deriving themselves from its inward Recesses. † g g. † h h. † i i i i i i i i.

The optick Nerves † take their rise from the *Medulla oblongata*, and afterward creep out of the Brain, and after some space are inserted into the Eyes. † k k.

The olfactory Nerves are Two pair, of which the least † seemeth to spring out of the Second row of Processes (endued with an oval Figure) and after some space, are inserted into the greater Trunk of the first pair of olfactory Nerves. † l l.

The greater pair of olfactory Nerves † do sprout out of the Apices of the first rank of Processes, and after an Inch or more, are branched obliquely on each side into the numerous Fibrils † making a fine System, the immediate Organ of Smelling. † m m. † n n n.

The lower Region of the Brain of a Skait seemeth to be composed of Three ranks of Processes, and an odd one.

The First rank † are made of Two pair of Protuberancies, endued with a kind of pyramidal Figure. † a a.

T. 61. F. 1.
The upper
Region of
the Brain of a
Skait taken
out of the
Skull.

T. 61. F. 2.
The lower
Region of the
Brain of a
Skait.

† b b.

The Second rank † are made up of Three Processes, of which the middle one is orbicular, and the lateral are adorned with an oval Figure.

† c c.

The Third rank † are also composed of Three Processes, of which the middle is the least, and are all adorned with a kind of triangular shape.

† d.

† e e.

The odd Process † is seated between the Third rank of Processes, and the *Cerebellum* †, which in its lower Region as well as upper, is parted into Two equal portions, adorned with an inverted pyramidal Figure, whose Base is seated in the beginning, and its Cone in the termination of the *Cerebellum*.

On each side of the *Medulla Spinalis*, is seated a Cavity, (full of Crystalline Liquor) beautified with an oval shape.

† f f f f.

The fine Systems of Fibrils † springing out of the Trunks of the olfactory Nerves, are endued in their lower Region with a Concave, and in their upper with a Convex Surface.

T. 62. F. 1.
The Brain of a
Thornback
taken out of
the Skull.
† a a.

The Brain of a Thornback somewhat resembleth that of a Skait, and is made up of Four pair of Processes.

The First pair of Protuberancies † are the greatest of all, and may be called *Pyriform*, as they resemble a Pear in Figure, and terminating in the olfactory, as in stalks.

† b b.

The Second pair of Processes † are the smallest, and seem to resemble a triangular Figure, consisting in unequal sides.

† c c.

The Third pair of Protuberancies † are endued with a short oval shape.

† d d.

The Fourth pair of Processes † are adorned with an oblong oval Figure.

† e e.

The Fifth pair † belong to the *Cerebellum*, beginning more large, and end in more small Dimensions, and in some sort are endued with a pyramidal Figure.

† f f f f.

The *Cerebellum* is encompassed on each side in some sort, after the manner of a Skait, with Processes † resembling Intestines, or the *Anfractus* of a Humane Brain.

† g g g g.

† G G.

† h h.

† i i i i.

Last of all, the *Medulla Spinalis* † appears (garnished on each side with numerous Nerves †,) and parted in the middle by the mediation of a Fissure † dividing the *Medulla Spinalis*, as into equal portions.

The Nerves of the Eyes † are double, as consisting of Two pair, the one Motory, the other Optick, and arise out of the sides of the *Medulla oblongata*.

† k k.

The olfactory Nerves † seem to arise out of the Apices of the *Pyriform* Processes, and make their progress obliquely crossways; and near their Terminations, are trimmed on each side with many small Fibres (covered with a Black Tunicle †.) the immediate instrument of Smelling.

† l l l l.

T. 62. F. 2.
The lower
Region of the
Organ of
Smelling in a
Skait.
† a a.
† b b.

The Organ of Smelling † in this Fish, is much more conspicuous in the lower Region (endued with a Concave Surface) in which the nervous Fibrils, † sprouting out of the Trunk of the olfactory Nerves may be more clearly seen, running in transverse parallel lines.

The upper Region of the Brain of a Kingston consisteth in three pair of Processes; The first pair † (much resemble those of a Skaite and Thornback) as adorned with a Pyriform Figure: The second pair of Prominencies †, are dressed with a kind of Oval shape: The third pair are graced with the Figure of *Mamillæ*, and thereupon may be called Mammillary Processes †.

T. 62. F. 3.
Of the Region of the Brain of a Kingston.
† a a.
† b b.

The *Medulla Spinalis* in this Fish is very remarkable, as being double in its Origen. The interior or middle † is parted into equal parts by a small Fissure, and is much less then the other to which it is united after an inch or more †.

† c c.
† d d.

The outward *Medulla Spinalis* at first is divided from the Interior by a double Fissure † passing on each side, and parting the external *Medulla Spinalis* into equal portions.

† e e.
† f f.

The lower Region of the Brain of a Kingston is very like to the upper, in number, shape, and size of Processes, which is very rare in other Fish.

T. 62. F. 4.
The lower Region of the Brain of a Kingston.

The Brain of a Codlin is composed of two pair of Processes; The first † and the least, are beautified with an Orbicular figure.

T. 63. F. 1.
The Head of a young Cod opened.

The second pair of Protuberancies † are adorned with an Oval shape.

† a.
† b b.
† c c.

The *Cerebellum* is made of two Processes †, standing opposite to each other, and are graced with a Pyramidal figure.

The beginning of the *Medulla Spinalis* † is parted by a Fissure (running in the midst) into equal portions.

† d d.

The Optick Nerves † take their rise from the *Medulla oblongata*.

† e e.

The Olfactory Nerves †, pass on each side of the Orbicular Processes, and pass in length till they arrive near the Mouth, and in two small Prominencies, out of which do sprout many small Fibrils † the immediate Organs of Smelling.

† f f.

† g g.

The lower Region of the Brain of a young Cod, consisteth in Five Processes, one single one, and two pair of Processes.

T. 63. F. 3.
The lower Region of the Brain of a Codlin.

The single one † is adorned with an Orbicular figure, and the first pair of Processes are beautified with a Conical figure †, beginning and ending in acute Cones.

† a.
† b b.

The second pair of Processes † is dressed with an Oval figure.

† c c.

Above the inferior Processes of the Brain, do offer themselves several Plexes of Nerves dispensed into many parts. The first branch † coming out of this Plex, is carried upward and inserted into the Eyes.

† d d.

The next Plex of Nerves hath divers Branches, one † is carried near the upper part of the Mouth. And others † to the Muscles of the Face, ending into a broad Expansion.

† e e.
† f f.

The third Branch †, coming out of the same Trunk, is opposite to the Smelling Nerves, and is implanted into the Muscles of the Neck.

† g g.

At the lower end of the Processes is seated the beginning † of the *Medulla Spinalis*.

† h h.

The Head of a Lamprey being opened, the Brain seemeth to be composed of two pair of Protuberancies, and a single one seated between them.

F. 3. The Head of a Lamprey opened.

The first pair † are somewhat the larger, adorned with an Orbicular figure.

† a a.
† c c.

The second pair † are endued with an Oval shape. The single Process

† seated

† seated between the two pair of Protuberancies, is beautified with a triangular Figure.

† Under this Prominence arise the Optick Nerves † from the *Medulla oblongata*, and pass obliquely to the Eyes.

† Below the second pair of Processes, the *Medulla Spinalis* † seemeth to take its Origen.

† Above the first pair (being Orbicular Protuberancies) are seated two round Cavities † parted from each other, and encircled with white Membranes.

† Above these Cavities appeareth a white Membrane beset with many long narrow streaks †, like so many Rays, and are numerous Filaments of somewhat a more dark colour then the Membrane.

† The Olfactory Nerves do terminate into many Filaments † (running cross-ways) which are the Organ of Smelling.

F. 4. The
Teeth of a
Lamprey.
† a a a a a a.

† The Mouth of a Lamprey is garnished with many ranks of pointed Teeth †, (running in Circles and Semicircles) somewhat resembling the Teeth of a Saw in figure.

† Some of the Teeth are covered with a Case † furnished with many holes adapted to the Teeth in shape and size.

† The Brain of a Trowt is composed of two pair of Processes, and the last being single, maketh the *Cerebellum*.

† The first pair of protuberancies † are very much the smaller, beautified with an Orbicular figure.

† The second pair are endued with an oblong Oval shape, adjoyning below to the *Cerebellum*, and above to the Orbicular Processes.

† The lowermost process † is beautified with a Triangular figure, which is the *Cerebellum*.

† Below this Process appeareth the Origen of the *Medulla Spinalis* † parted into equal parts by the interposition of a Fissure.

† The Optick Nerves † seem to arise under the Orbicular Processes, and to be derived from the *Medulla oblongata*, and passing cross-ways, are inserted into the inside of the Eyes.

† The Olfactory Nerves † also seem to creep under the Orbicular Protuberancies, and take their rise from the *Medulla oblongata*.

† The Brain of an Umber much resembleth that of a Trowt in the number and figure of Processes, only the *Cerebellum* differeth, as being adorned with a kind of Orbicular shape.

† The first pair † of Processes are decked with an Orbicular figure.

† And the second pair † with an oblong Oval shape.

† And the *Cerebellum* † is beautified with an Orbicular figure.

† A little below, as it were coming out of this process, may be discerned the origen of the *Medulla Spinalis* †, divided into equal portions by a Fissure.

† The Optick Nerves † seem to sprout out of the oblong Oval Processes, and bend their course obliquely toward the inside of the Eyes.

† The Olfactory Nerves † seem to arise out of the Orbicular Processes, and bend their progress in straight Lines toward the Mouth.

† The Head of a Carp being opened the Brain seemeth to be composed of five ranks of Protuberancies, and one single one.

T. 64. F. 1. The
Head of a
Carp open-
ed.

The

The first row † consists only in two Processes, dressed with an Oval Figure. † a a.

The second rank † is made up of four Prominencies, trimmed with an Orbicular shape. † b b.

The third row † of Processes are bigger then the former, and are endued with an oval figure, standing obliquely. † c c.

The fourth † is one single Process dressed with an irregular shape. † d.

The fifth rank † is adorned with a kind of oval or pointed Processes. † e e.

The single Process † is small and seated between the last Protuberancies, and is beautified with a triangular figure. † f.

The Nerves of the Eyes † are double, the one Optick, the other Motory, and seem to arise out of the first pair of Processes. † g g g g.

The Olfactory Nerves † begin in Knots, and are carried close for some space, and afterward part, and near their terminations have two orbicular Prominencies †, and are at last branched into many Filaments (running transversely after the manner of a Scolop Shell †) the immediate Organs of Smelling. † h h. † i i. † k k.

The Brain of a Carpe is every way above and below and laterally im- mured with a transparent clammy Liquor, endued with an innumerable company of Specks, † or minute Globules of a yellowish colour, somewhat resembling the Lytharge of Gold: And here I beg the freedom to speak my Conjecture about the first production of this Viscid Matter, whence its transparency proceedeth, and as such it clearly bespeaketh its Conception and Nativity, as the progeny of the more clammy parts of the Seminal Li- quor, receptive of Concretion caused by Saline Particles; So that this sub- stance, *in solutis principiis*, in its primitive nature, being beautified with Transparency, may well retain it, when coagulated into a more solid con- sistence; and being formerly fluid, as Seminal Liquor, hath its constituent parts aranged in orderly positions, fitted to receive Transparency, by reason it being formerly a fluid Body, during which time it was easie for the subtle bright rays of Light to pass through the Pores, and make them- selves passages every way, and afterward so to dispose the more minute Par- ticles, when consolidated, to retain the same Pores through which the beams of Light were transmitted, when it had the more loose nature of a liquid form, which afterward growing more solid with the same passages of Light, keep the same primitive constitution of a Transparent Body, when meta- morphosed into a more solid substance bespangled with a numerous train of little Specks, or yellowish Globules (of a yellowish colour, resembling the Lytharge of Gold) produced of the more dense and opaque Particles of the Seminal Liquor affected with disorderly Pores (not answering those of the transparent substance) which do shut out the beams of Light transmitted through the more regular passages of the other Transparent Body.

F. 2. Of the
Transparent
substance en-
circling the
Brain of a
Carp.
† a a a.

The upper Region of the Brain of a Carp is here added, by reason I found it (upon Dissection) much different from the former.

In this Brain I discovered a great *Lusus naturæ* (as oftentimes in other Fish) which hath numerous Prominencies †, sporting themselves in various shapes, magnitudes, and irregular situations, interspersed with numerous running pleasant Mæanders †. These different Protuberancies do not an- swer each other in ranks, but seem to be confused, as not seated one against another (as in the regular Brains of Fish) and the Processes are not of the same figure,

F. 3. The
upper Region
of the Brain
of a Carp ta-
ken out of the
Skull.
† a a a a a.

† b b.

† cc. figure, which is only found in the first pair of Processes † endued with somewhat of an orbicular figure, and small if compared with divers other Protuberancies; Some are of the same shape and much greater, but not seated in pairs opposite to each other, but in confused positions. Other Processes seem to resemble Semicircles in figure: And the posterior Prominencies are the greatest; and the most Minute are seated for the most part on the Margent of the Brain; So that in fine, this system of various Processes (relating to the Brain of a Carp) do seem to resemble a bunch of Grapes of greater and less size, confusedly growing to the Stalk.

F. 4. Of the
brain of a
Carp.
† aa.

† b.

† cc.
† d.

The lower Region of the Brain of a Carp, is garnished with eight Processes of several magnitudes. The first pair †, are somewhat small, endued with an Oval figure, and coated with a red colour. The Prominencies † (confusedly placed between the first and last pair) are four in number, small in size, and orbicular in figure.

The Posterior pair of Processes which are much the greatest, are seated near the *Medulla Spinalis* †, and hued with a red colour, and of an oval figure. The *Medulla Spinalis* † is parted in the middle by a Fissure.

For the most part, the Processes, besetting the *Medulla oblongata*, both above and below, are Red, and inclining somewhat to a cineritious colour, as being Cortical. And there are three Prominencies, which are White, as being chiefly made of a Medullary substance.

F. 5. The
Head of a Ro-
chet opened.
† aa.
† bb.

† cc.

† d.

The Brain of a Rochet, consisteth in two pair of Processes; The first pair † are much less in size then the other, and are beautified with an Orbicular figure; The second pair † of Protuberancies are adorned with an Oval shape.

The last pair of Processes † make the *Cerebellum*, and are endued with a kind of inverted pyramidal figure, having their Bases above, and Cones below, toward the *Medulla Spinalis*.

The beginning of the *Medulla Spinalis* †, as also its farther progress, is divided into two equal portions by the interposition of a Fissure.

F. 6. F. 1.
The Head of a
Prill opened.

† a.

† b.

† c.

† d.

† e.

† ff.

F. 2. The
Head of a
Place opened.
† a.

The Brain of a Prill is irregular, as the Processes of one side do not answer the other, either in figure, magnitude, or number.

The right side of the Brain of this Fish is composed of two Prominencies, the first † is minute and orbicular.

The second Protuberance † is much greater, and beautified with an Oval figure.

The left side is composed of a double number, of four Processes; The two first † are seated in the Van, and are adorned with a small Orbicular figure.

The third Process † of the left side is much more enlarged, and dressed with an Oval figure.

The fourth † of this side is endued with an Oblong figure somewhat resembling an Oval shape.

The Optick Nerves † are of unequal length.

The Brain of Place is also irregular, as being confused in the situation, shape, size, and number of its Protuberancies.

The first row of Processes are two in number †, and seem to be endued with a minute Orbicular figure.

The

The second row $\dagger$, seem to be three in number, (of which the largest $\dagger b$ are seated in the middle) adorned with an Oval shape.

In the close of the Prominencies, is seated a single Protuberance $\dagger$ on the right side of the *Medulla Spinalis*, and is (as I conceive) the *Cerebellum*, which is very minute in this Fish.

The Olfactory Nerves $\dagger$ do creep under the anterior Processes, and take their progress toward the Mouth in straight lines.

The Optick Nerves $\dagger$ are different in length; The Right being shorter than the Left.

The Brain of a Dabbe is disorderly in figure, size, and number of its Processes.

F. 3. The Head of a Dabbe opened.

The first Process $\dagger$ is single standing toward the right side of the Brain.

The second Processes $\dagger$ are seated directly opposite to each other, the middle Prominence is adorned with a round shape.

The other Protuberancies of this row $\dagger$, are seated on each side of the middle Prominency, and are adorned with a kind of Oval figure.

The posterior Processes $\dagger$ are many, seated in a Cluster, of different shapes and sizes.

The *Medulla Spinalis* $\dagger$ is divided into equal parts by a Fissure.

The Optick Nerves are various in length, the left being longer than the other.

The Brain of a Flounder is composed of various Processes of different shapes and sizes; The three first $\dagger$ run in length in a kind of Line, and have various figures and magnitudes.

F. 4. The Head of a Flounder opened.

The next Protuberancies $\dagger$ are also three in number seated in a row, and are beautified with an Orbicular figure.

The posterior rank of Prominencies $\dagger$ seem to be endued with an Oval figure, the middle only appeareth fair, shading the other, making them to represent a Semicircular figure.

The last Prominency $\dagger$ is single, placed on the right side of the *Medulla Spinalis*, and seemeth to be adorned with an Orbicular shape, and is the *Cerebellum* in this Fish.

The *Medulla Spinalis* $\dagger$ near its Origen hath larger dimensions, and groweth less and less, of a pyramidal figure.

The Nerves of the Eyes are two pair, one being Optick $\dagger$ (which are the uppermost) and the left is longer than the right.

The other pair are Motory $\dagger$, and exceed the other in greatness.

The Olfactory Nerves $\dagger$ creep under the minute first Processes, and pass toward the Mouth in a straight progress, and end in Fibres.

The Brain of a Soale hath divers Processes $\dagger$ seated in the Origen of the Brain, and endued with several figures and magnitudes, and grow less in size, as they approach the Mouth.

F. 5. The Head of a Soale opened.

After the anterior Processes follow a pair $\dagger$ larger than the former, endued with an Oval figure.

The posterior Process is single $\dagger$ (seated on the right side of the *Medulla Spinalis*) adorned with an Orbicular shape.

The *Medulla Spinalis* $\dagger$ is parted by a Fissure running in the midst.

$\dagger d d$

The Optick Nerves $\dagger$, as in many other flat Fish, are endued with an unequal length.

$\dagger e e$

The Olfactory Nerves $\dagger$ creep out of the Brain under the cluster of anterior Processes, and go in a straight course.

$\dagger f f$

The Brain of a Turbat is very regular in the situation, size, and figure of its Processes.

F. 6. The Head of a Turbat opened.

The first rank of the upper Region $\dagger$ are two in number, dressed with an Orbicular shape.

$\dagger a a$

† b b b.

The second row † consist in three Prominencies. (beautified with an Oval figure) of which the biggest are seated in the middle.

† c.

The posterior Process †, is somewhat of a Triangular figure, and is the *Cerebellum*.

† d d.

The Optick Nerves † are of a different length, and the right exceedeth the other in dimensions.

† e e.

The Olfactory Nerves † do arise under the first pair of Processes, and take their course in straight lines.

The lower Region relating to the Brain of this delicate Fish, is furnished only with three short oval Protuberancies.

And I have observed in the Brains of Fish, that their lower Region hath less Processes then the upper, which I have seen in many Dissections.

† f.

The *Medulla Spinalis* † (as in other Fish) is parted by a Fissure.

T. 66. F. 1.

The upper Region of the Brain of a Whiting.

† a a.

The upper Region of the Brain of a Whiting is formed of six Processes of different shapes and sizes.

The first pair of Protuberancies †, being the smallest of all, is adorned with an Orbicular figure.

† b b.

The second pair † being above double in magnitude, are beautified with an oblong oval shape.

† c c.

The third pair of Processes † are adorned with an inverted pyramidal figure, as their Bases are above and the Cones below; and do constitute the *Cerebellum* divided in the middle by a Fissure.

† d d.

† e e.

Below it, may be seen the *Medulla Spinalis* † out of whose beginning on each side of it a Nerve doth arise †, which climbing up, do encircle the Processes of the *Cerebellum* and Brain, and afterward intersect the Optick Nerves, and passing all along the Head, do intersect each other, and at last terminate into Arches.

† f f.

The Optick Nerves † do creep out of the Brain under the Orbicular Processes, and pass obliquely into the inside of the Eyes.

† g g.

The Olfactory Nerves † creep out of the Brain under the Orbicular Processes, and do associate for some space, and afterward part, and are at last implanted with various Fibrils into the Organs of Smelling †.

† h h.

F. 2. The lower Region of the Brain of a Whiting.

† a.

The lower Region of the Brain of a Whiting, consisteth in a row of five Processes, and the most minute is seated in the middle † dressed with a Globular figure.

† b b.

The inward adjacent Processes † are trimmed with an oval shape.

† c c.

The outward Protuberancies seem to be pointed †, beginning in acute and ending in obtuse Cones.

F. 3. The Head of a Pearch opened.

† a a.

† b b.

† c.

† d.

F. 4. The lower Region of the Head of a Pearch opened.

† a a.

† b b.

F. 5. The Head of a Gudgeon opened.

† a.

† b.

The upper Region of the Brain of a Pearch is made up of two pair of Processes, and of a single Protuberance.

The first pair † are the smallest, and decked with an Orbicular figure.

The second pair † are adorned with an Oval figure.

The last is a single Process †, beautified with a kind of triangular figure.

The *Medulla Spinalis* † is parted in the middle (as in other Fish) into two equal parts.

The lower Region of the Brain of a Pearch is endued with four Processes seated in a rank, the two middle Prominencies † are dressed with an Oval figure, and the two lateral † (as they are placed by Nature) seem to enclose the middle Processes after the manner of Semicircles.

The Brain of a Gudgeon is composed of three pair of Processes; The first †, are endued with a minute Orbicular figure; And the second pair † are somewhat larger, and are beautified also with the same figure.

The

The third pair are the largest, adorned with an Oval shape.

The two last are single † Processes †, placed one below another, the one great and the other small, and both Orbicular, and make the *Cerebellum*. † c c. † d.

The *Medulla Spinalis* † is disposed into equal parts by the mediation of a † f f. Fissure running in the middle.

The Olfactory Nerves † arising under the minute pair of globular Processes, make their progress toward the Mouth. † e e.

The Brain of an Eel consisteth in two ranks of Processes, and a single Protuberance. F. 6. The Head of an Eel opened.

The first rank † hath three in number, dressed with a Globular figure. † a.

The second rank † hath two decked with an Oval. † b b.

The posterior Process † seemeth to be adorned with a quadrangular figure. † c.

The *Medulla Spinalis* † is little different from that of other Fish, as consisting of two parts, equally divided in the midst by a Fissure. † d d.

The Optick Nerves † seem to be derived from each side of the lateral orbicular Processes, seated in the first rank, and pass in an oblique transverse posture, and are inserted at last into the inside of the Eyes. † e e.

The Medulla Oblongata and Spinalis of Animals.

The *Medulla oblongata* of a Rabbit is a system of many Processes which are seated in a double row † parted from each other by a Fissure †. T. 70. F. 1. The Medulla oblongata of a Rabbit.

The origin † of the *Medulla oblongata* of this Animal hath two Arms †, and each of them is composed of four or five Processes. † a a a a a. † b b b. † c c c c. † d d.

The ranks have smaller Processes † (endued with an Oval figure, toward the beginning, and have larger Ovals † about their termination, and end in three orbicular Processes †. † e e e e e. † f f f f. † g g.

The *Medulla Spinalis* is made up in its origin of two ranks of Processes, the two highest † are beautified with a pyramidal figure †, and the rest seem to be parallelograms, † parted from each other by a Fissure. The Medulla Spinalis. † h h. † i i i i. † k k.

The *Medulla oblongata* of a Gray Mullet, is a fine Compag made up of many ranks of orbicular Processes, and have only three (in their origin or Neck †) which are the more minute, out of which the Optick Nerves † do arise F. 2. The Medulla oblongata of a Gray Mullet.

The body of the *Medulla Spinalis* in this Fish seemeth to be a fine system composed of five Orbicular Processes, of which the next to the Neck are the greatest †. † a a. † b b.

The *Medulla Spinalis* is divided into two parts, by a Fissure †, and doth not consist in any Processes, which are found in a Rabbit. † c c. The Medulla Spinalis. † d d.

The lower region of a Gurnard seemeth to be made up of five Processes, the anterior are a pair † much larger then the rest, endued with an Oval figure; out of these Processes arise the Optick Nerves †, intersecting each other. F. 3. The lower Region of the Medulla oblongata of a Gurnard. † a a. † b b. † c.

The three posterior Protuberancies † are very minute, beautified with an Orbicular shape.

The *Medulla oblongata* is framed of two rows of Processes, of which the anterior Protuberancies † are the most large, and grow less toward their termination, and are all of an Oval figure. † d.

The *Medulla Spinalis* is parted by a Fissure †, and destitute of Processes. The Medulla Spinalis. † e e.

The *Medulla oblongata* of a Carp, is composed of two ranks of Protuberancies (parted from each other by a Fissure †) beautified with an Orbicular figure. F. 4. The Medulla oblongata of a Carp. † a a.

Its origin consists in two single Processes, of which the first † is of a kind of Oval figure †, and the second is adorned with an Orbicular †. † b. † c. † d.

The first pair of Processes † are the greatest, and lead the Van in the Company † e e.

The Medulla
Spinalis.
† f f f.
F. 5. The Me-
dulla oblongata
and Spinalis of
a Pike.
† a.

pany of Protuberancies, which grow less and less as they approach the *Medulla Spinalis* composed of two parts, severed from each other by a Fissure †.

The *Medulla oblongata* of a Pike beginneth in an apex or obtuse Cone †, and the body of the *Medulla* is a Compag framed of four rows or more of small orbicular Processes.

The Medulla
Spinalis.
† b b.
F. 6. The Me-
dulla oblongata
and Spinalis of
a Gudgeon.
† a.

The *Medulla Spinalis* in this Fish as well as most other, is constituted of two parts separated from each other by a Fissure †.

The *Medulla oblongata* of a Gudgeon is integrated of a double rank of Protuberancies endued with a round shape.

Its origen † begins in an obtuse Cone, and seemeth to be composed of three ranks of small Processes † of an Orbicular figure.

† b b b.
† c c.
† d d.
The Medulla
Spinalis.
† e e e.

The body † of the *Medulla oblongata* is framed of a double rank (severed by a Fissure †) beginning large, and growing less and less as they come toward the *Medulla Spinalis*, which is divided into two parts by a Fissure † running all along the Spine.

F. 67. F. 1. The
Head of a
Dory opened.

The Brain of a Dory is composed of five Processes endued with greater and less Ovals.

† a a.

The first pair † are the least, and are endued with a short Oval figure.

† b b.

The second † are much greater, adorned with an oblong Oval shape.

† c.

The last Process † is Oval too, and is the *Cerebellum*.

The *Medulla Spinalis* consisteth in two equal parts (divided in the middle by a Fissure) resembling a pyramidal figure.

† d d.

The Optick Nerves † seem to creep under the first pair of Oval Processes, and passing in an oblique transverse posture, are at last implanted into the inside of the Eyes.

F. 2. The
lower Region
of the Brain
of a Dory.
† a a.

The lower Region of the Brain of a Dory taken out of the Skull, is made up of five Processes as well as the upper.

† b b.

The first pair † are Orbicular.

† c c.

The second pair seem to be Conical, beginning and ending in Cones, and are adjacent to each side of the *Cerebellum*.

The last Processes † divided in the middle by a Fissure, when conjoyned, do resemble a Triangle, and are the *Cerebellum*, which is sometimes one Process, and other times two, as in this Fish.

F. 3. The
Head of a
Gurnard
opened.
† a a.

The Brain of a Gurnard is framed of nine Protuberancies, somewhat like a cluster of Grapes.

† b b.

The first pair † seem to be endued with an Oval figure.

† c c c.

The second pair † are dressed with a kind of triangular shape.

The third rank of Processes † are three in number, the two lateral seem to be beautified with a kind of Semicircular figure; and the middle Process with a Triangular.

† d d.

The last pair of Processes † are the least, and are endued with an oval figure.

† e e.

The Optick Nerves † creep under the first pair of Processes, and take their progress in a transverse posture, and are inserted into the inside of the Eyes.

F. 4. The Head
of a Smelt
opened.

The Brain of a Smelt is made up of seven Protuberancies consisting in three pair and an odd Process

† a.

The first pair † are very small and of an Orbicular figure.

† b b.

The second pair † are endued with an Oval shape.

† c c.

The third pair † are adorned with an Oval figure.

† d d.

The posterior Process † (being the *Cerebellum*) is beautified with a kind of Triangular shape.

† e e.

The Optick Nerves † in this Fish seem to arise under the second pair of Processes, and tend toward the inside of the Eyes obliquely cross-ways.

† f f.

The Olfactory Nerves † do arise under the first pair of Processes, and climb upward toward the Mouth.

The

The *Medulla Spinalis* † in this as in other Fish, is divided into equal parts, † g g. endued with a pyramidal figure.

The Brain of a Pope consisteth in nine Processes, various in size and shape. The first rank † being two in number, are very minute, and of a Conical figure. The second rank † are made up of two Processes which are very small. The third rank † of Prominencies are the greatest of all, as dressed with an Oval figure. The posterior Process † (being the *Cerebellum*) is also beautified with an Oval shape. The *Medulla Spinalis* † passing under the posterior Process, is dressed with an inverted pyramidal figure.

The Brain of a Herring is framed of nine Processes. The first row † are a pair of Processes, beautified with an Orbicular figure. The second rank † are much larger then the former, and are adorned with an oblong Oval shape. The last Process † is dressed with a triangular shape. The *Medulla Spinalis* † is much like that of other Fish in figure, only it seemeth not to be divided into equal parts by a Fissure.

This Fish is very remarkable for its Head, as having a long Process affixed to it, full of many Asperities, as so many Teeth, holding its Aliment when first seized. This oblong Process much resembleth the Beak of a Woodcock, Godwit, or Curlue in figure. The Brain of this Fish consisteth in four pair of Protuberancies. The first † are the most minute and seem to be endued with a Conical figure. The second pair † appear to be adorned with a Triangular shape, and do exceed the first in dimensions. The third pair † are the largest of all the Processes, and are adorned with an oblong Oval figure. The fourth pair † are dressed with a kind of inverted pyramidal, by reason their Bases are placed upward and their Cones downward: This pair doth constitute the *Cerebellum* of this Fish. The *Medulla Spinalis* †, is much akin to that of other Fish in situation and figure.

The Brain of this most delicate Fish is composed of three pair of Protuberancies. The first † are beautified with a kind of triangular shape. The second pair of Processes † are adorned with an Orbicular shape. The third pair † are dressed with an Oval figure, parted by a Fissure in the middle into two equal parts, which make the *Cerebellum*. The Optick Nerves † are like those of other Fish in situation and progress, and do arise under the first pair of Processes, and take an oblique transverse course toward the inside of the Eyes.

The Brain of this Fish is made up of three pair of Prominencies. The first pair † are very small, and dressed with an Orbicular figure. The second pair † are much greater then the first, and are decked with an oblong Oval figure. The third pair † are Ovals, and as I conceive, do represent the *Cerebellum*. The *Medulla Spinalis* † is the same with other Fish both in shape and situation.

The Brain of this Fish seemed to be composed of many Processes. The first rank † are three in number, endued with a Globular Figure. The second row † are a pair of Oval Protuberancies much like the other in bigness. The third † seem to consist in three Processes, the middle one is † endued with an Orbicular shape, as the other being lateral, seem to be endued, as far as they appear, with Semicircular figures. The posterior Process †, being the *Cerebellum*, is dressed with a Triangular figure. The *Medulla Spinalis* † is divided into equal parts, by the mediation of a Fissure.

The lower Region of the Brain of a Horse-mackrell, is composed of four Protuberancies †, which are endued with a Globular figure.

The Brain of a Pike is composed of five Processes of different Figures and Magnitudes. The first pair †, are dressed with a short Oval, or rather Orbicular

F.5. The Head
of a Pope
opened.
† a a.

† b b.

† c c.

† d.

† e.

F.6. The Head
of a Herring
opened.
† a a.

† b b.

† c.

† d.

T.68.F.1. The
Head of a
Garfish open-
ed.

† a.

† b b.

† c c.

† d d.

† e e.

† e e.

† e e.

F.2. The Head
of a Gray Mul-
let opened.
† a a.

† b b.

† c c.

† d d.

† e e.

F.3. The Head
of a Salmon
Pearl opened.
† a a.

† b b.

† c c.

† d d.

F.4. The Head
of a Horse-
Mackrell
opened.
† a.

† b b.

† c.

† d d.

† e.

† f f.

F.5. The
lower Region
of the Brain
of Horse-Mac-
krel. † a a a a.

T.69.F.1. The
Head of a Pike
opened. † a a.

+ b b. bicular figure. The second + are very much larger then the first, and
 + c. beautified with an oblong Oval figure. The posterior Process + is adorned
 with a Triangular figure, and is the *Cerebellum* in this Fish. The *Medulla*
Spinalis + is not different in figure and parts from that of other Fish.

+ d.
 F. 2. The low-
 er Region of
 the Brain of a
 Pike. + a a.

+ b b.

+ c c.

F. 3. The Head
 of a Tench
 opened.

+ a.

+ b b.

+ c.

F. 4. The low-
 er Region of
 the Brain of a
 Tench. + a.

+ b b.

F. 5. The Head
 of a Pearech
 opened.

+ a a.

+ b b.

+ c c.

+ d.

+ e.

The lower Region of the Brain of a Pike consisteth of four Processes dif-
 ferent in figure and magnitude. The two uppermost + seem to be dressed
 with an Orbicular figure. The last + have the appearance of a short Oval
 shape. The Optick Nerves in the Base of the Brain being turned up, do
 plainly appear to intersect each other.

The Brain of a Tench is composed also of five Protuberancies, somewhat of
 a different Figure from a Pike. The first pair + are the least, and seem to be
 endued with a short Oval figure. The second pair + of Processes are adorn-
 ed with an Oval figure too. The posterior Process + seemeth to be beautified
 with an Orbicular figure.

The lower Region of the Brain of a Tench is composed of three Proces-
 ses. The first Process + is endued with an Oval shape. The pair of Pro-
 tuberancies + are adorned with an Oval figure.

This Brain is much different from that of the third Figure of the Sixty
 sixth Table, and consisteth in ten Protuberancies. The first pair + are
 dressed with a kind of Orbicular figure. The second pair + are adorned
 with an Oval shape. The third pair + of Prominencies are trimmed with
 an Orbicular figure. The seventh Process + is beautified with a kind of Tri-
 angular figure. The three last Processes + are placed after the manner of a
 Triangle, and are endued with several shapes and sizes.

The 70th. Table of the *Medulla oblongata* and *Spinalis*, placed in the
 middle of the 1121 Page, should immediately follow the 69th. Table.

C H A P.

C H A P. LXIV.

Of Sleepy Diseases.

HAVING discoursed the Excellent Fabrick of the Brain, in reference to its Coats, *Anfractus*, and Glandules, Compag, and as it is a composition of greater and less Tubes and fibrous parts, the first rudiments and constituents of the Nerves.

Now with your permission, I will entertain you with the more doleful History of its Pathology, first recounting its Sleepy Diseases, which have much affinity with each other, and differ in degree (only a Lethargy hath a Fever attending it) and do proceed from the venenate nature of the Blood in Malignant and Pestilential Fevers infecting the Nervous Liquor, and taking it off from its tone and vigor in the substance of the *Cortex*.

The Sleepy Diseases differ in degree. A Lethargy is accompanied with a Fever.

These stupefying Diseases are also derived from a quantity of Serous Recrements in the Scorby and Dropsie, lodged in the *Anfractus*, therein compressing the origins of the Fibers, and hindring the free reception of the Animal Juice into their Extremities, causing an eclipse of its lucid rays.

The causes of stupefying Diseases.

Or else from an Exuberance of watry Particles stagnant in the spaces of the Vessels, where they associate with the Nervous Liquor, rendring it vapid and dispirited, making the ambient parts of the Brain flabby and loose, do despoil the Nervous Fibrils of their due tenseness, thereby producing unnatural Sleep.

And I humbly conceive that these torpid disaffections have their birth not only from corrupt Elementary dispositions, but from a kind of mineral Nitro-sulphureous Particles, first infecting the Blood and afterward the Nervous Juice, taking away its Volatil parts of the Animal Liquor, rendring them fixed, and unfit for motion, whereupon the Nervous Cortical Fibrils grow flaccid, whence floweth a stupid and unkindly Sleep.

Torpid Diseases coming from Mineral Particles.

As to the Apoplexy, the most fatal of all soporiferous Diseases, as accompanied with most dreadful symptoms, of snorting, and great difficulty of Breathing, and sometimes Convulsive motions proceeding from sharp acid humors vellicating the Nerves.

And the continent cause of this terrible stroke, incident to this Distemper, may be fetched from a Serous Liquor concreted in the *Cortex* of the Brain, whence the production of Nervous Liquor is hindred in the *Cortex*, or at least the motion of the Animal Spirits intercepted into the extremities of the Fibrils.

The continent cause of stupefying diseases.

Madam *Mayser*, a Person of Quality, being recommended to my care, frequently vomited in her Sickness, a quantity of acid Matter, and æruginous Choler, with which her stools were often tinged, making them of a dark greenish colour, and for a Fortnight or more she was tortured with many severe Convulsive motions, with which she was so much weakned, that she was constrained to lift up the Glass with both hands when she drank, and for many days before she died, was not able to cut her Meat, her hands were so afflicted with trembling motions, the Fore-runners of a sad Apoplectick Fit, which happened upon a most discontented Person, recounting some unpleasant events, and was attended with great belching, and a loud Shreech, and the Convulsive motions of her Lips, Face, and Eyes, ending in a fall from her Chair, where she fate; and afterward being thrown upon a Bed, was violently hurried with great Convulsions of the Muscles of her Limbs, and Trunk of her Body, determining in a difficulty of breathing, and great Stertor, in which she expired in a Fit of Twenty four hours.

The Instance of an Apoplectick Fit.

Her Skull being taken off, and the Brain stripped of the *Dura Mater*, a great

great company of Vesicles full of Serous Liquor discovered themselves, and the *Cortex* of the Brain being wounded, a large quantity of gross coagulated *Serum* was squeezed out, with which the *Cortex* did every where superabound, but the Medullary parts, the *Corpus Callosum*, *Fornix*, *Medulla oblongata*, *Corpora striata*, *Nates*, *Testes*, and the *Cerebellum* were free from this concremented *Serum*, or from any luxuriant Blood, or purulent Matter; whereupon I humbly conceive, the conjunct cause of this Apoplectick Fit, to proceed from this gross *Serum* stagnant between the *Striae* of the *Cortex*, which were so compressed, that the Nervous Liquor prepared in the *Cortex*, could not be received into its minute Fibrils, the first origin (as I conceive) of the Nerves of the Brain, whence the course of the Animal Spirits being stopped, a privation of all the Animal functions ensued, the horrid Concomitants of the tragick Apoplectick Fit.

The seat of an Apoplexy.

The course of the Animal Spirits is intercepted near death.

The Blood groweth stagnant near death.

The current of Blood is made good by Inosculation of Blood-vessels.

An Apoplexy is produced by an inundation of Extravasated Blood in the substance of the Brain.

Another cause of an Apoplexy.

This is a Disease, as acute as dangerous, seated often in the *Corpus Callosum*, and *Medulla* of the Brain, where the more noble Operations are exerted, and is produced by eclipsing the bright influx of the Animal Spirits hindring their motion into the Fibres and Nerves springing out of the Brain and *Medulla Spinalis*, which is caused either by obstruction or compression (as Learned *Webster* will have it) arising from the stopped current of Blood, as it is impelled by the Carotide Arteries into the substance of the Brain, which is rather a consequent than a cause of an Apoplexy, when it proveth fatal, near the approach of death: Whereupon the course of the Animal Spirits is intercepted, that they cannot pass into the inward Recesses of the Brain, and flow into the branches of the *Par Vagus* and Intercostal Nerves, implanted into the Heart, Diaphragm, and Intercostal Muscles, when the Heart and Lungs quitting their motions, the Blood groweth stagnant, and is not impelled through the *Aorta* and Carotide Arteries, into the ambient and more inward parts of the Brain, which rarely happen as a cause preceding an Apoplexy, because the motion of the Blood into the Brain cannot easily be so universally suppressed, as to produce an Apoplexy, which to prevent, the Carotide and Vertebral Arteries, have so many communications with each other by frequent Inosculations, that if any of those numerous Arterial Branches be left free, they will supply the defect of the rest, and the Blood may be conveyed by various Anastomoses from one Arterial Branch to another, into the outward and inward Coasts of the Brain; But I conceive, with permission to this great Author, that an Apoplexy is more commonly generated by a great source of extravasated Blood, making an inundation in the substance of the Brain, into which so great a quantity of gross Blood is impelled, that the minute Orifices of the Capillary Jugulars are not able to receive, and return it in the circulation, but is lodged in the empty spaces running between the Fibres, which being enlarged beyond their due dimensions, do crush the Filaments, and check the motion of the Animal Liquor, into the substance of the Brain and Nerves.

Another cause of an Apoplexy (as I conceive) may proceed from an Ulcer of the Membranes of the Brain, in whose substance so great a quantity of Blood being settled, that it cannot be discharged by the Jugulars, whence the Purple Liquor being destitute of motion, it soon loseth its tone, and the bond of mixtion being loosened, and the Nutricious part being separated, and corrupted, degenerateth into a *Pus*, which first corrodeeth the Membranes, and afterward the Medullary parts and secret passages of the Brain, and doth at once obscure both the brightness of the Animal Spirits, and intercept their passage into the Nerves, determining at last in a sad Apoplectick Paroxysm.

And

And further, I conceive that the cause of an Apoplexy doth not only arise from an abscess of the Membranes, and *Medulla* of the Brain, and from *φλεγμονή*, not caused by a large effusion of Blood, issuing out of the extremities of the capillary Arteries, and stagnant in the empty spaces interceding the Vessels, but from too great proportions of Blood, thrown out of the greater into the smaller Branches, so highly distending them, till they are lacerated, and their impetuous torrents make great Cavities and *Sinus* in the *Medulla* of the Brain, and by tearing in pieces the tender Fibrils, do interrupt the due progress of the Nervous Liquor, and Animal Spirits, closing in a doleful Catastrophe of an Apoplectic Fit.

An Apoplexy derived from Blood extravasated in the Interstices of the Vessels lodged in the substance of the Brain.

Renowned *Webster* giveth an instance of this case, happening in an old Woman of Seventy years, which being quickly taken away by an acute Apoplexy, and her Skull being taken off, he discovered a large Cavity in the stance of the Brain, reaching forward toward the Forehead, and upward to the *Processus Falciformis*, and much backward toward the *Occiput* and downward beyond the middle of the Brain. The longitude of this unnatural *Sinus* was Four Inches in breadth, Two and half in depth, and Eight in length, containing near a pound of extravasated Blood, that had issued out of the lacerated carotide Arteries, which did not proceed from any outward accident, as this profound Author saith, there having been no contusion or fracture discoverable in the Skull; but I conceive from the greater source of Blood, protruded out of the larger Carotides into the smaller Capillaries (branched into the *Medulla*) which had been more and more dilated by the Rivulets of Blood, till the coats of the Arteries were over-much distended, and thence growing thinner and thinner, at last cracked in pieces, and the streams of confined vital Liquor were forced through the breaches of the Arterial Coats, into the substance of the Brain, and made great Furroughs and Channels in it, and by tearing up the Medullary Filaments, did divert the natural course of the Animal Liquor and Spirits from the Nerves.

An instance of an Apoplexy.

A Daughter of Mr. *Lewis*, one of the Navy-Office, a Person of a Plethorick Constitution, was highly afflicted with a great Head-ach, which afterward degenerated into a *Sopor*, and was much alleviated upon Blood-letting, and then she fell into a Rheumatisme, placed in the Muscular part of the Limbs.

Another case of an Apoplexy.

And in order to ease her, I designed to open a Vein a second time, but was prevented by the importunate dislike of her Friends, giving an advantage to her distemper, to re-assault her Brain with a fresh pain of her Head, accompanied afterward with a great *Sopor*; whereupon I made a Prognostick, That the distemper would determine (as I apprehended) in an Apoplectic Fit, unless she was relieved by an immediate opening a Vein, which I conceived the proper means to preserve her; but her Friends highly interposed, and hindred my intention of Bleeding her; whereupon in a few days the *Sopor* grew more violent, attended with a *Stertor*, and then the Patient falling into a violent Apoplectic Fit, died in Twelve hours: And after a competent time, her Head being opened, the Coats of the Brain were swelled, and a large quantity of serous Matter was found in the substance of the Brain.

As to the cause and progress of the Disease, I conceive it to be after this manner: Free Rivulets of Blood, overcharged with serous Particles, being impelled out of the Carotides into the Membranes and substance of the Brain, produced the Head-ach, and *Sopor*, which were much mitigated up-

The cause and progress of this Disease.

on Bleeding; whereupon the Blood freely retired from the Brain, by the Jugulars, into the *Cava* and Chambers of the Heart, and thence was carried upward again by the ascendent Trunk of the *Aorta*, and subclavian and axillary Branches into the Limbs, causing great pains in the Shoulders and Arms; and at the same time another portion of Blood was conveyed downward by the descendent Trunk of the *Aorta*, and Iliack Arteries into the Thighs and Legs, which being reconveyed by the Iliack Veins, and ascendent Trunk of the *Cava*, into the Ventricles of the Heart, and from above by the axillary Veins, and descendent Trunk of the *Cava*, into the *Sinus* of the Heart; and from thence again, a quantity of Serous Blood was impelled by the *Aorta* and Carotides into the Coats and substance of the Brain, highly compressing the Filaments, and thereupon wholly suppressing the descent of the Animal Liquor, into the roots and bodies of the Nerves.

The immoderate use of Opiates may produce an Apoplexy.

Another cause may be assigned of an Apoplexy, (seated in the *Cortex* of the Brain) the immoderate use of Opiates, as Learned *Webster* would have it, by too great a dilatation of the pores of the Brain, exposing it to a violent incursion of ill humors, brought along with the Blood, and giving a disturbance to the regular motion of the Animal Liquor; But I humbly conceive (with the leave of this Learned Author) that Opiates do rather obstruct, and shut up the Pores of the Brain, then immoderately open them, and make ill impressions upon the Animal Liquor, and by incrassation, and fixation of the Spirits, in taking away their volatil, airy, elastick Particles, do unbrace the natural Tenseness of the fibrous parts of the *Cortex*; and by consequence do take away the vigor of the Nerves of the whole Body, whence the motion of the Heart groweth weak, from its distorted Fibres, attended with a great difficulty of Breathing, flowing from the flabby Fibres of the intercostal Muscles, proceeding from the nervous Liquor, dispirited by Narcoticks.

An instance of an Apoplexy produced by Opium.

Mrs. *Jane Reynolds*, a young Gentlewoman being passionately in love, and not succeeding well in her Amours (as she conceived) took Twelve pills of Opium in so many Cherries, every Pill, as I apprehend, contained about Ten grains of Opium; an hour after she had taken the Pills, she began to be dozed and giddy, and although an hour after she swallowed the Pills, she took great quantities of Oil and Medicines to provoke Vomiting, yet without success, she being hard to vomit in time of her health; and upon this sad occasion, the Fibres of her Stomach were so stupified and relaxed by the Opium, that they could not contract themselves to expel the Vomit.

Opium stupified, and relaxed the Nerves.

Two hours and less after she had taken the Opium, a great Stupor seized her Brain, and rendred the Muscles of the *Gula* so Laxe, that she wholly lost the use of it, being not able to swallow; and immediately after was afflicted with a great difficulty of breathing, which grew higher and higher, so that the Muscles of the *Scapula* were drawn in to the assistance of the intercostals and Diaphragme, which being not able of themselves to perform their duty in respiration, were attended with a high *Stertor*, which was more and more aggravated from Twelve at Night till Five in the Morning, about which time Nature being too much over-born, quitted all farther contests.

Two hours after the Head being opened, and the Brain being divested of its coverings, the carotide Arteries did much exceed their natural Dimensions, and their spaces of the Vessels, swelled with undue proportions of Blood, though a good quantity of it was discharged by the venous Ducts into the Third *Sinus*, full of Blood; which the Head lying low, was afterward transmitted by the lateral *Sinus* down to the Base of the Brain, where I discerned

a great

a great inundation of Blood, so incrassated by the Opium, that the extremities of the Jugulars were not receptive of it.

So that upon the whole it is most evident that this poor Love-sick Gentlewoman was her own executioner in the immoderate Dose of Opium, which caused a quantity of Blood to stagnate in the *Cortex*, in which it compressed the roots of the Fibrils, denying the access of nervous Liquor into them, and so fixed the Animal Spirits, that they were rendered useless, as being incapable to invigorate the fibrous parts of the Brain and Body.

Opium rendered the Blood stagnated in the substance of the *Cortex*.

An Apoplexy also may proceed, not from concremented ferous Liquor only, but from Blood too, coagulated (in blasted persons upon Thunder, or the like) in the *Cortex* and Medullary part of the Brain, which hindreth the generation of nervous Liquor in the *Cortex*, and distribution of it through the Fibrils of the Brain.

An Apoplexy may proceed from coagulated Blood, upon a Blast, by Thunder.

This Disease also may be derived from the prohibited circulation of Blood, caused by a suppressed motion of the Heart in a Syncope, or Hysterick passion; whereupon the Blood cannot be impelled out of the Heart into the common and ascendent Trunk of the *Aorta*, and carotide Arteries into the *Cortex* of the Brain, in order to the production of Animal Liquor and Spirits.

An Apoplexy may also be derived from the motion of Blood, intercepted in the Ventricles of the Heart in a Syncope. This disaffection may proceed from the Convulsive motions of the Cardiac Nerves. And a *Narcosis* of the Animal Spirits may come from malignant steams of the Air.

This disaffection of the Heart and Brain, as being destitute of a due proportion of Blood, is often produced by the convulsive motions of the Cardiac Nerves, and a suddain *Narcosis* of the Animal Spirits, (not only disaffected in the Processes of the Brain, but *Cerebellum* too) which take their rise from some malignant steams, flowing from the ill influxes of the Stars poisoning the Air, which is received by the Nostrils, and conveyd by secret Pores into the Medullary Processes. and cineritious part of the Brain, wherein the Animal Liquor and Spirits are often vitiated, and dispirited, and the functions of the Brain wholly abolished, as in an Apoplexy.

If it be inquired, what is the nature of the matter of this Disease; it may be replied, it is of an abstruse disposition, hard to be understood, and is not, as in Convulsive diseases of a nitrous sulphureous temper; but of a Spirituous-saline, in which the Animal Spirits are fixed, as losing their agile, spirituous, elastick Particles; whence are propagated the Sleepy diseases of an Apoplexy, *Coma*, *Carus*, &c.

The nature of Sleepy Diseases consist in Spirituous Saline Matter.

The differences of an Apoplexy, in short, may be these, The one is habitual, which proceedeth from a gross Cachochymical Blood, caused by an ill concoction of the Stomach, and Intestines, transmitted to the Brain; or by an ill constitution of the nervous Liquor.

The Second kind of Apoplexy, is immediately derived from a more strong cause, productive of it, without procatactick causes; This Disease is seated in the Brain sometimes, and other times in the *Cerebellum*; frequent vertiginous Dispositions do denote it to be in the Brain, and an intermittent Pulse, Syncope, and fainting Fits shew the Disease to be in the *Cerebellum*, as Dr. Willis hath observed, in the Eighth Chapter *de Apoplexia*, Pag. 271. *Cerebrum huic morbo magis obnoxium denotant præviæ & frequentes scolomix, & vertiginis affectus: Cerebellum male affectum arguunt, creber incubus, pulsus intermittens, Syncope, & Lipothymia frequens.*

An Apoplexy is seated sometime in the Brain, and other times in the *Cerebellum*.

This Disease admitteth another difference according to its diverse degrees, as it is more or less strong, which is discovered by the disaffection of the intellectual, or sensitive operations of the Brain, or of all of them; and the greatness of their malady is shewn very much in the eminent difficulty of Breathing, and a general abolition of all animal Functions.

The difference of an Apoplexy, according to several degrees. The greatest difficulty of breathing is a great sign of a most high Apoplexy.

As

The Sym-
tome of an
Apoplexy at-
tendant of
Death.

As to the Prognosticks of this fatal Disease, it is always attended with eminent danger, and very commonly with Death, which is accompanied with an universal taking away the functions of, and with an ill intermittent Pulse, a froth of the Mouth, and cold colliquative Sweat, the fore-runner of Death: And Blasted persons are frequently exposed to a deadly Fit of an Apoplexy, appearing in a total privation of Pulse and Breathing, associated with cold Sweats, the doleful Heralds of approaching Death.

A sleepy Disaffection (called by the *Latines*, *Carus*) is near akin to an Apoplexy, differing from it only in a less degree (and often degenerates into it) as having the Animal faculties less violated, in reference to the inward and outward Senses, as it is a deep Sleep, with a privation or immutation at least, of the intellectual and sensitive Functions, accompanied with a free Respiration, which is always deficient in an Apoplexy.

A *Carus* is a
lower Sleepy
Disease then
an Apoplexy.

In a *Carus* the Sleep is less deep, from which the Patient may be awaked by a loud voice, or by pulling or pinching him; whereupon he will open his Eyes, and will have only a very confused apprehension of any thing said to him, which is wholly taken away in an Apoplexy.

The seat of this Disease is conceived to be not only in the *Cortex*, but in the ambient part of the *Corpus callosum* too, in which the Animal Liquor and Spirits, are very much confined, as not having a free motion into the more inward Recesses of the *Corpus callosum*, and other Processes of the Brain.

The Conti-
nent cause of
a *Carus*.

The continent cause of a *Carus* is the same in substance, but different in degree from that of a *Coma* and Apoplexy, it being lower then the first, and higher then the later disease; and the stupifying Maladies have different denominations (as the Morbifick Matter groweth more or less strong) and successively arise out of each other, as the later is an increase of the former.

Gross Hu-
mors do in-
tercept the
motion of the
Blood, caus-
ed sometimes
by obstructi-
on, and other
times by com-
pression, made
by the tumor
of the adja-
cent parts.
The Progn-
osticks of a
Carus.

Sometimes the Matter of the Disease is at once so highly exalted, that without degrees, it is the cause of a *Carus*, or Apoplexy; so that gross Humors do vitiate the Nervous Liquor and Animal Spirits, and intercept their motion sometimes by Compression, by the tumor of the adjacent parts, as well as by the obstruction of the Origin of the Nervous Fibrils (seated in the *Cortex*) by faculent Humors, which happens in Blood, confederated with gross Chyme, or with a *Pus*, after a broken Abscess, following an inflammation of the Membranes of the Brain.

As to the *Prognosis* of this Disease, it importeth great danger, as having much affinity with an Apoplexy, especially when it succeedeth a malignant or any acute Fever, not critically determined; or it happens in Child-Bed; or when it followeth other dangerous diseases of the Head. This disease sometimes is turned into an Apoplexy, and other times into a Palsie.

A *Coma* is a
more mild
Disease then
an Apoplexy
or *Carus*.

A *Coma* is a milder disease then a *Carus*, as having the Morbifick Matter, less in degree then the former Maladies, and is of a stupifying quality, producing a *Sopor*, out of which, when the Patient being awakened, will return an answer, and presently after will fall asleep again, lying with an open Mouth, and a relaxed lower Jaw, somewhat resembling the approaches of death. This disease often accompanieth malignant Fevers, and is sometimes a forerunner of a *Carus* and Apoplexy.

The seat of a
Coma.

This disease is seated in the Cortical part, and about the *Anfractus* of the Brain, and doth not penetrate the more deep Processes, and *Sinus*. This Malady is very much related to a *Carus*, and Apoplexy, and hath the same causes, only the matter of the disease is less exalted, and is lodged about the more ambient parts of the Brain, and procedeth frequently from the narco-

tick

tick steams of the Blood (having recourse to the Membranes, and Cortex of the Brain) derived from the venenate nature of malignant Fevers.

A Lethargy is also a sleepy Disease, and more severe then a Coma, and hath its denomination *ἀπὸ τῆς λήθης, ἢ ἀργίας* *Ab oblivione & inertia, quasi dicas obliuionem inertem*: As Sennertus hath it. So that a Lethargy is an affection, engaging the Patient in a constant inclination to sleep, accompanied with the diminished Functions of Reason, Imagination, and Memory; as also with a continued slow Fever, in which it differeth from a Carus and Apoplexy which are more high and dangerous diseases.

The nature of a Lethargy.

A Lethargy is seated in the more inward Recesses of the Brain, and not only in the *Anfractus*, and Cortical part; And is styled by *Avicen*, *Apostema Phlegmaticum, genitum in meatibus substantiæ Cerebri*; Whereupon the Antients did conceive a Lethargy to be a Tumor of the Brain derived from a putrefied Phlegme, productive of an Inflammation; But I humbly conceive, that this Disease often taketh its rise from serous Recrements, overflowing the substance of the Cortex, and more inward parts of the Brain, which hath been discovered in Dissected persons, dead of a Lethargy, having the more ambient parts, and more inward substance surcharged with watry Humors, found in Hydropique persons.

The seat of a Lethargy.

The symptoms of a Lethargy.

This Malady may also be produced by a nervous Liquor, not well acted with good Animal Spirits, as wanting their noble elastick Particles; whereupon they labour with a kind of *Narcosis*, productive of Sleep and Forgetfulness.

The cause of a Lethargy.

This Disease is produced by a kind of *Narcosis* of the Animal Spirits.

A Lethargy may be produced from ill Humors of a venenate nature.

This Disease may be derived from a quantity of Humors lodged in the ventricles of the Brain.

An Instance of this case.

A Lethargy is generated, not only by a quantity of serous Recrements, but a venenate nature of ill Humors (in malignant Fevers) transmitted by the internal Carotide Artery, into the substance of the Medullary, and Cortical part of the Brain.

Sometimes this Disease is caused by a source of Humors, lodged in the Ventricles, proceeding from a fall, lacerating the Blood-vessels; whereupon the watry Recrements being severed from the vital Liquor in the Interstices of the Vessels, is carried from thence into the Chambers of the Brain; whence ariseth a Lethargick disposition, accompanied with a Fever.

An Instance may be given of this case in a young Man, having received a blow upon his Head; whereupon he fell into a Stupor with a Fever, and complained of a great pain in his Head, losing his Speech, which could not be recovered by Bleeding, and the applications of Cupping-glasses, and other methodical courses of Physick, concluding his miserable days in a happy departure. Afterward his Skull being taken off, his Brain appeared very moist, and the Ventricles over-charged with a quantity of serous Recrements.

This Disease may also come from an Ulcer of the Brain, discharging its purulent Matter into the Ventricles, and Choroidal Plexes.

A Lethargy may be fetched from an Ulcer of the Brain, backed with this Instance.

A young Man about Eighteen years old, labouring with a severe pain of his Head, often vomited, and for the most part was confounded with a deep sleep (and a gentle Fever) taking away much of the use of his Reason, Memory, and Imagination; and after many applications had been made, which were not crowned with success, he patiently submitted himself to the Will of his Maker, resigning his Soul into his Gracious hands.

And afterward his Brain being opened, the vessels of the *Pia Meninx* appeared to be highly tumefied, and the Falciforme Process being taken away, the Third Sinus was found full of Blood, and the lateral Sinus being opened, were discovered to be full of purulent Matter; and the inward surface

of these Ventricles, were rendred rough and unequal, and their substance flabby, which being squeezed with a gentle Hand, a Pus oused out of the adjacent parts, into the Cavity of the Ventricle; and afterward the Choroidal Plexe being opened, was found tainted with these putrid Humors.

A Lethargy
proceeding
from the
Coats of the
Brain, adhe-
ring to each
other; where-
upon they be-
came Scirr-
hus
An Observati-
on.

A Lethargy may also proceed from the growing together of the Membranes of the Brain, wherupon they sometimes become Scirrhus, produced by the Saline Particles of serous Recrements, converting the membranous Compage of the *Dura* and *Pia mater* into a solid, indurated substance.

A Woman complaining of a severe pain of her Head for many Months, fell into a great *Sopor*, attended with a Fever, which at last cut off the thread of her life.

And the Skull being taken off, on the side of the Third *Sinus* appeared a Scirrhus Tumor, accreasing to the Membranes of the Brain, whence they grew together, by the interposition of a concreted hard substance infesting the coats of the Brain, and intercepting the motion of the Blood, caused by the compression of the Scirrhus Tumor.

A Lethargy
coming from
the fracture
the Skull.

Persons are also obnoxious to this Disease upon cuts and fractures of the Skull, and wounds of the Brain, so that a quantity of Blood either compresseth the Membranes, in fractures of the Skull, or the substance of the Brain overfloweth with Blood in wounds; whereupon ensueth a *Sopor*, accompanied with a Fever, sometimes determining in an Apoplexy.

An Observa-
tion upon this
case.

I saw a Brewers Man, upon a great blow of his Head, oppressed with a great Lethargy and Fever, which ended in an Apoplexy after some few hours; and the Scalpe being taken off, a great Fracture appeared, having pierced both Tables of the Skull, which being taken off, a quantity of Blood was discerned to be lodged upon the *Dura mater*, which compressed the Blood-vessels, and hindred the motion of the Blood into the *Cortex*, and produced the Lethargy, ending in an Apoplexy.

A Gentleman receiving a wound in his Eye by a Tobacco-pipe, which forthwith entred into the substance of the Brain, producing a great *Sopor*, ending in death.

Afterward the Brain being opened, a wound was discovered in it (near the Eye) oppressing it with extravasated Blood, which sometimes suppurates and corrupts the substance of the Brain, generating first a Lethargy, and then an Apoplexy.

The Sleepy
Diseases being
akin in their
causes, are
much alike in
Cures too.

Having given a short History of the Nature, and causes of Sleepy Diseases, it may be now pertinent to speak somewhat of their Cures, which are very much alike, as they hold great affinity one with another.

And I will begin with an Apoplexy (as the highest of sleepy affections) in reference to the preservatory indication, or to its Fit, which often proceedeth from a quantity of Blood, and its intercepted motion, caused either by the grossness of Blood, or Compression, produced by the Tumor of the adjacent parts, which do all Indicate a free mission of Blood out of the jugular Veins, or out of the Arm, which may be again and again repeated in a plethorick Body. And Clysters may be administred, prepared with Emollients and Discutients, to which may be added the leaves of Rue, *Species Hiera*, the lenitive Electuary, &c.

Vomitores.
Cupping-
Glasses.
Vesicatories.

Vomits may be given, prepared with Salt of Vitriol, in compound Walnut-water, Oxymel of Squills, or infusion of *Crocus metallorum*, taking often free draughts of Posset-drink, between the vomiting.

Cupping-glasses may be applied to the Shoulders and Neck, and to the top of the Head, according to *Fracastorius*; As also blistering Plaisters made large and strong,

strong, may be used and affixed between the Shoulders, and to the Neck, and the inside of the Arms, near the Axillaries. Strong Purgatives are also very proper in this Disease, prepared with Amber, *Cochia minores*, *Extract. Rud. Fatid. M.* quickened with some grains of *Trochisc*, of *Albandal*, or *Diagridium*.

Strong Purgatives may be given in this Disease.

Julapes may be given, made up of Distilled Water of Lilly of the Valley, Lime Flowers, Rue, compound Pæony, Compound Briony, Spirit of Lavender, to which may be added some drops of Spirit of Hartshorn, Spirit of Smoke, Castor, Salt Armoniack succinated, &c.

Julapes.

As also gross Powders (prepared with Amber, Castor, *Galbanum*, *Asa fetida*, &c.) may be thrown upon Embers, and the Fumes received into the Nostrils, and the Temples and Nostrils may be anointed with Oil of Amber, Spirit of Castor, apoplectick Balsome, to which may be added some drops of Salt Armoniack succinated.

Suffumigations.

Ointments.

The top of the Head being shaved, may be annointed about the Coronal and Sagittal Suture with Oil of Amber, Spirit of Lavender, &c. and a hot Frying-pan may be held near the Head to warm it, and the Oil and Spirits, that they may have the greater influence upon the Brain.

And in desperate Apoplectick Fits, a Red hot Iron may be held near the Coronal Suture, and *Occiput*, that its heat and pain may reduce the Patient to Sense.

Or a strong Blistering Plaister applied to the coronal Suture, which is more safe, and less troublesome. And the Body being universally purged by proper Medicines given with Cephalicks, particular Evacuations may be advised.

Whereupon the excretory vessels of the Tongue and Palate, may be opened by Gargarismes, that the Oral Glands may discharge the Recrements of the Blood, and sollicit its motion, by opening the terminations of the Carotide Arteries, inserted into the substance of the Oral Glands; To this end, roots of Pellitory, boiled in simple Oxymel, to which some Castor may be added, and Mustard-seed powdered, and mixed with Honey, or else boiled in strong White-wine, may be applied to the Palate.

Gargarismes or Apophelmatismes.

Sternutatory Powders may prove very beneficial in this Disease, made of Majoram, Seeds of *Nigella*, Pepper, Castor, to which may be added some grains of White Ellebore, and Pellitory: Fumes also may be received into the Nostrils, coming from Vinegar (prepared with the Seed of *Nigella*) Rue and Castor thrown upon a Red hot Iron. As also shavings of Hartshorn, and the Clawe of an Elke, or Feathers, or Hair of a Goat cast upon Embers, and held under the Nostrils, have great efficacy to remove a deep Sleep, and comfort the Brain, which is the nature of all Fætid.

Sternutatories.

Frictions of the soles of the Feet with Vinegar and Salt, with Hands anointed with Oil of Rue, Spirit of Castor, &c. speak great advantage in Fits of an Apoplexy.

Frictions.

The Head may be bathed with Vinegar, in which the Berries of Bays and Juniper, the Roots of *Angelica*, *Imperatoria*, and the leaves of Betony, Rue, Sage, Rosemary, Majoram, Winter-Savory; the Flowers of Lavender, Sage, Betony, Rosemary, Pæony, &c.

Fomentations.

After the Fomentation, a *Sacculus* may be applied to the Head, made of the Spices of Nutmegs, Cloves, Mace; Cubebs, and the Flowers of Betony, Sage, Majoram, Rosemary, &c.

A Sacculus.

A preservatory method of Physick may be advised to persons, that have escaped one or Two Apoplectick Fits, as subject to them.

In

In this case, purging Medicines may be advised, of Senna, Agarick, Rubarb, Flowers of Pæony, Sage, Rosemary, &c. infused in Distilled Waters of Flower of Lime, Pæony, mixed with a little White-wine, to which (being strained) may be added Syrup of Buckthorn, Peach-flowers, and Syrup of Roses solutive.

Bleeding proper in this course.

Afterward Bleeding may be freely celebrated, which by lessening of the quantity of Blood, and by making good its circulation, doth prevent Inflammations, Abscesses, Ulcers of the Brain proceeding from the stagnation of Blood, the great cause of an Apoplexy.

Vomitories may be given after Purgatives. Fontanels.

When a Purgative hath been celebrated, Vomitories may be administered made with some proper Emetick.

Electuaries.

Afterward Two large Fontanels may be made between the Shoulders, to divert and discharge some ill Humors, having recourse to the Head, to prevent the Apoplectick Fit; in order to it, an Electuary may be advised, prepared with Conserves of Lime-Flowers, Lilly of the Valley, Pæony, the Powders of Amber, Castor, Pearl Coral, and Humane Skull, the Seeds of Pæony, and Goats-Rue, made up with the Syrup of Lime-Flowers.

Apozemes.

After which, a draught of an Apozeme may be taken, prepared with the Flowers of Betony, Sage, Rosemary, Lavender, and with *Viscus Quercinum*, or *Viscus Pomorum*; to which may be added *Stercus Pavoris*, and when it hath been well boiled in Spring-water, and strained, it may be sweetened with Syrup of Lime-Flowers, Pæony, or Lilly of the Valley.

Powders.

Powders also may be advised, made of Pæony-root, and of *Species Diambræ*, Castor, Angelica, Zedoary, *Contragerua*, and of the chips of Oranges and Lemons, drinking after every Dose, a draught of a proper Julape, or Apozeme.

A *Carus*, *Coma*, and Lethargy, being all Sleepy Diseases, have great alliance with an Apoplexy, and do admit the like method of Physick, and Medicines prescribed in an Apoplexy, the highest of all Sleepy Diseases.

CHAP.

C H A P. LXV.

Of the Vertigo, or Meagrum.

A Vertigo, or Meagrum is here Treated of, as a fore-runner to the Apoplexy, and the other Sleepy Diseases, and is seated in the ambient parts, and more inward Recesses of the Brain; the allodgments of the Animal Spirits (in which their first rise and motion is produced) the ministers of the inward Senses, as well as the intellectual Functions.

A Vertigo is often a fore-runner of Sleepy Diseases.

These active emissaries of the Soul, the more refined Particles of the Animal Liquor, sometimes exalt the Processes of the Brain in great companies, and other times in smaller numbers, and are carried in irregular motions, highly discomposing the fibrous Compage of the Brain, wherein the lucide Particles suffer a total Eclipse, as in an Apoplexy, or a lesser in a *Carnus*, *Coma*, and Lethargy, in which some glimmerings of the more noble and sensitive operations of the Brain appear.

My Province at this time is to discourse a vertiginous disposition, sometimes a Herald of greater Maladies, the Sleepy Diseases of the Brain, wherein the Animal Spirits have their motion sometimes disordered, and other times stopped, so that they cannot be duely ministerial to the production of the Animal Operations.

A Vertigo proceedeth sometimes from a disordered, and other times from an intercepted motion of the Animal Spirits. The description of a Vertigo.

A Vertigo is a disaffection of the Brain, wherein the objects of sight seem to wheel round with a great swimming in the Head; so that the Animal Spirits are highly discomposed, as suffering a great confusion, produced by an irregular Motion; whereupon they have not a due influence, first into the Fibrils of the Brain, and afterward into the Optick Nerves, productive of a lost, or diminished sight, and progressive motion.

In the Paroxysme of this Disease, the inward Senses admit a deception, while reeling Objects seem to be hurried in motion; and the rational Conception is not much disturbed, while we apprehend the discomposure of our inward and outward Senses.

The Paroxysm of a Vertigo.

As to the cause of this Malady, its worth our inquiry how it is made, in Diseases, or by a violent motion of the Body in a circular manner, or by a prospect from a high place, of some low distant Objects, seated immediately, or directly under us, or by going over narrow open Bridges, placed over great and deep waters, running in hasty torrents; or in a Ship under sail, carried with an impetuous motion in a strong Tempest.

The causes of this Disease.

Whereupon the Animal Spirits run so confused, that they cause a vertiginous disposition, which may seem worth our consideration, to understand the reason of this discomposure, as conducive to the better understanding the intrinsic causes of a Meagrum.

When we have long hurried our Bodies in a circular motion, all outward objects seem to dance round about us; and though we repose our selves, yet this phancy continues; and sometimes we tumble down upon the ground, or floor, and have an apprehension of a circular motion in our Brain.

A Vertigo coming from a disorderly motion of our Body.

And the reason may be, not that the disaffection is lodged in the outward Sense, or there continued, but from the agile temper of the Animal Spirits,

(as Learned Dr. Willis hath well observed) Cap. 7. De Vertigine, Pa. 250. Quippe (ait ille) affectus iste a corporis circulatione producitur, sive oculis intuemur, sive nictamus: At vero hujus apparitionis causa omnino dependet a fluxili spirituum animalium substantia; quippe spiritus intra Cerebrum scatentes, non secus habent ac aqua aut densa vaporum congeries phialæ inclusa, quæ una cum vase continente circumagitur, & facta semel vortice, etiam vase quiescente motum istum aliquandiu continuare persistit; pari etiam modo quando hominis corpus circumgyratur, spiritus cerebri incolæ, ab ista capitis, tanquam vasis continentis, circumductione, in motus tornatiles ac veluti spirales aguntur; cumque propterea solito influxu, & directo jubare nervos irradiare nequeant, hinc una cum visibilium rotatione, sæpe Scotomia & pedum vacillatio inducuntur. Hemisphaerium visibile rotare videtur, quia spiritus speciem excipientes, circulariter moventur; quare siquidem sensibilis impressio recipitur per modum recipientis, prout spiritus, ita objecta in orbem moveri videbuntur.

And the prospect of disagreeable Objects, or a dangerous situation, or motion of the Body, giveth a suddain surprisal, and striketh a dread into the phancy, and rendreth the motion of the Animal Spirits irregular and confused.

The Animal Liquor is highly discomposed by immoderate drinking.

And in persons debauched with great proportions of Wine, or strong Liquors, the Blood is disordered with fierce and turbulent steams, which being carried into the Brain, do give a high disturbance to the Animal Liquor and Spirits (generated of the serous part of the vital juyce) by offering a violence to them, by rendring their motion inordinate, and confused.

In these external, or evident causes of a preternatural disposition of the Brain, producing a Meagrum, the Animal Spirits, are disturbed in their natural Emanations, by a confused progress, and various agitations hither and thither, within the Interstices of numerous nervous Fibrils, in the ambient parts, or more inward Recesses of the Brain; so that the natural motion of the Animal Spirits being checked, and rendred confused, they do not flow regularly into the Nerves of the Eyes; whereupon the visible Objects seem to admit a Circumrotation, which is not truly in them, but a deception of the Sight, proceeding inwardly from the fluctuation of the Animal Spirits, which are (as I humbly conceive) carried forward and backward in various disordered motions.

The inward causes of a Vertigo.

Having discoursed the evident causes, generating a vertiginous affection of the Brain, I shall endeavour now to give some account of the more inward, and preternatural causes of it: So that a Vertigo is sometime a symptome, as a consequent of another Malady. And other times it is not an accident, but a Disease, as produced within the Processes of the Brain.

A vertiginous symptome is first of all produced by the motion of the Blood, checked in the Heart or Lungs; whereupon followeth a Syncope, or Lypothimy, a difficulty of Breathing, and a great lightness of the Head.

A Vertigo coming from irritation of the nervous Fibrils.

Othertimes, vertiginous symptomes arise from the irritation of the Nervous Fibrils of the Stomach, Intestines, Liver, Pancreas, Spleen, Kidneys, proceeding from sharp Recrements, which offending the said Fibrils of the Viscera (taking their Origen from the Brain) give a lightness to it; and it is frequent in Abscesses and Ulcers of the Thighs, Legs, and Feet, to have the Head affected with a Vertiginous disposition; which happens also to persons having long fasted, which doth not come (as commonly imagined) so much from steams, ascending out of the empty Stomach to the Head; but I humbly conceive, it is borrowed from the Fibrils of the Stomach, destitute of Alimentary Liquor, (which highly gratifieth the Nerves) produ-

cing

cing small motions in the Fibrils, which draw the Nerves of the Brain into consent, and cause a kind of swimming of the Head, which disappears after the assumption of Aliment, refreshing the nervous Fibrils of the Stomach, and appeasing their gentle Contractions.

Having spoke of the Vertigo as it is a Symptome, it may be now proper to treat of it as a Disease, in which its Seat, Nature, and Causes are presented to our consideration, to give us a farther light in order to its Cure, to prevent greater Diseases, the sad followers of it.

A Vertigo considered as a Disease.

The seat of this Disease is not so much in the Cortex, as in the more inward Recesses of the Brain, the allodgments of the common Sense and imagination, which are very much disquieted in vertiginous affections; so that we are not capable to make right apprehensions of visible Objects.

The seat of a Vertigo.

The Animal Spirits borrow their Origen from the more mild parts of the Blood (exalted with Animal Liquor in the substance of the Cortical Glands) imparted to the *Corpus callosum*, *Fornix*, *Corpora striata* (the subject of the inward Senses) which are agrieved by the confounded motion of the Animal Spirits, as they are hindred in their progress through the Processes of the Brain, which is the very Essence of this Disease, or Continent cause of it; as some of them are clouded, others are diverted from their natural course, and move as it were in Gyres, making a kind of circulation, or rather a fluctuation, or retrograde motion, as the natural Emanations of the Animal Spirits are intercepted by some impediment of the nervous Fibrils, or secret *Meatus* of the Brain; Whereupon the highly discomposed Spirits, do render the Phantasmes disorderly, and the Images of things (in themselves quiet) restless, as running round after a kind of circumvolution: And as the lucid Particles of the nervous Liquor, cannot communicate a free and full Influx into the Nerves of the Eies, whereby the Rays of visible objects are much obscured; as the visible faculty groweth eclipsed by the darkned irradiation of bright Animal Spirits, as their more free motion is intercepted in the Interstices of the nervous Fibrils of the Brain.

The Origen of the Animal Spirits.

The Essence, or Continent cause of a Vertigo.

The manner how the Vertigo is produced.

If a search be made how the Animal Spirits are hindred in their passage through the empty spaces of the nervous Fibrils, (whereupon they are by force carried in a tumultuary motion) it may seem to have much shew of Reason, that the Animal Liquor is associated with heterogeneous fermentative Particles (originally derived from the serous parts of the vital Juyce the *Materia substrata* of Animal Spirits) which affect the refined Atomes of nervous Liquor with a confused motion, causing a vertiginous disposition; which may also proceed from an obstruction of the Interstices of nervous Fibrils (constituting the Compage of the Brain) So that the free course of the more agile parts of the nervous Liquor, have not a free progress into the Nerves, inserted into the Eies; whereupon they lose their true perceptive Faculty, attributing to the Objects a circular Motion, which is found only in the irregular course of the Animal Spirits, and not in the outward objects of Sight.

A cause of a Vertigo.

Another cause of a Vertigo.

An habitual and inveterate Vertigo may have its cause also assigned to the ill temper of the Brain, derived from a sharp and acide indisposition, proceeding from a company of serous Recrements, perverting the laudable affection of the Brain, impregnated naturally with sweet, and volatil saline Particles, not gross sæculent and fixed saline Recrements, which vitiate the laudable constitution of the Animal Liquor and Spirits, and render their motion confused and irregular, the immediate and conjunct cause of a vertiginous affection.

An inveterate Vertigo.

As to the Prognosticks of this Disease, if it be symptomatical, flowing from the indisposition of the *Viscera*, affecting the Brain; it hath less of danger, if it be a Disease not deeply radicated.

But an inveterate Vertigo, being almost continued, threateneth a greater danger, as more difficult to be cured, and giveth a Physician great trouble, before the Patient labouring with this stubborn Disease, can be recovered.

This Disease, when seated in the anterior Region of the Brain, is more safe, as making less impression upon it, and is often turned into the pain of the Head, and discharged many times by a flux of Blood flowing through the Nostrils.

A vertiginous affection having its subject in the hinder part of the Brain, attended with ill symptoms, as falling upon the Floor, and an ablation of the noble sensitive Functions is obnoxious to imminent danger, and sometimes degenerates into an Apoplexy, and other times into a Palsey.

This Disease, as to its Cure, admits a diverse consideration, in reference to its Paroxysme, or to prevent its Fit, which is preservatory.

The Fit denotes Bleeding.

Purgatives may be used, prepared with Cephalicks; as also Antiscorbuticks, Diureticks.

Purging Pills. Apozemes.

Julapes.

Tincture of Steel, or Powder of it, prepared, and given in proper Apozemes. Purgations must be now and then advised in a Steel course.

As to the First, it denoteth in a Plethorick Constitution, a free Letting of Blood in the Jugulars, Arm, or by Leeches in the Hemorrhoidal Veins, and in a great case by the application of Cupping-Glasses to the Shoulders and Neck; And as to the preservatory Indication in an ill habit of Body, purgative Medicines may be applied, prepared with Cephalicks. As also Chalybeats, mixed with Antiscorbuticks, and Diureticks, which I have seen give great relief in vertiginous distempers, as they discharge the Recrements of the Blood, which else being carried to the Brain, do take off the purity of the nervous Liquor, and Animal Spirits, and hinder their free progress, between the Filaments of the Nerves, seated in the various Processes of the Brain.

And to this end, Pills of Amber, mixed with *Extractum Rudii*, &c. As also Alteratives may be administered, as Apozemes made with the Flowers of Betony, Sage, Cowslips, Lilly of the Valley, Lime, &c. and to every Dose, some drops may be added of the Spirit of Hartshorn, of Salt Armoniack succinated; Conserves also made with these Flowers, mixed with Powder of White Amber, Castor, roots of Pæony, and Millepedes powdered, made up with Syrup of Lime-Flowers, or Lilly; drinking after every Dose, a good draught of a Cephalick Apozeme, to which may be added Ten or Twelve drops of Spirit of Castor.

Pearl Julapes, made of the Distilled waters of Cephalicks, and compound Pæony; to which may be added the Spirit of Lavender, and sweetned with refined Sugar.

Powders also may be advised, prepared with White Amber roots of Pæony, Coral, prepared Pearl, &c. and may be given in a Decoction of Cephalick Flowers of Rosemary, Betony, Sage, Tey, &c.

A Tincture, or Syrup of Steel, or its Powder prepared with Sulphur, may be advised to be taken with Cephalick Apozemes, made with the Flowers of Rosemary, Lavender, Pæony, &c.

Every Fourth or Fifth day, a gentle purgative draught may be prescribed, mixed with Cephalick Medicines, during the course of Steel.

C H A P. LXVI.

Of the Delirium and Phrenitis.

BEfore I Treat of a *Phrenitis*, I will discourse briefly of a *Delirium* (as preliminary to it) which doth not truly apprehend the Images of things, First presented to the outward Senses, and afterward imparted to the common Sense and Phancy, by reason the Animal Spirits are much clouded by an ill nervous Liquor; and as its due temper and motion is more or less perverted, it is productive of greater or less disaffections of the Brain, wherein the species presented from the outward to the inward Senses, are ill perceived, or unduely compounded, or divided; whereupon the Understanding being presented with distracted and confused Phantasmes, exerteth irregular operations, and giveth an ill conduct to the Will, in various misguided and unreasonable acts, which are all styled under a common Name of *Delirium*, which being in a less degree, and shorter in time, is vulgarly called a *Delirium*, and when it continueth longer, and more severe, as accompanied with a Fever, and other more troublesome accidents, is named *Phrenitis*, attended sometimes with Raving, and other times degenerates into a *Mania*, *Melancholia*, & *Stupiditas*, of which I will discourse in order, and First of a *Delirium* and *Phrenitis*.

The description of a *Delirium*.

Phrenitis, is a kind of *Delirium*.

A *Delirium* is rather a Symptome then a Disease, as being a shadow, following other Disaffections; My Province at this time is to make an inspection into the nature, and causes of the Malady, called *παραφρεσύνη*, by the Greeks, and *Delirium* by the Latines, and is a perverted operation of the Brain, flowing from malignant Fevers, Hysterick Paroxysmes, the eruption of the Small Pox, &c.

A *Delirium* is rather a Symptome then Disease.

This Symptome seemeth to be seated in the more inward Recesses of the Brain, where the common Sense, Phancy, and Memory do perform their operations, which are acted by the Animal Spirits, the Ministers of the Mind, which being hurried in irregular motions, do confound the representations of outward sensible Objects, when their Appulses are conveyed by nervous Fibrils, to the more inward sensitive Faculties, which being disturbed in their due apprehensions, do make disorderly Phantasmes, recommended to the Understanding; whereupon this more noble Function cannot make a right judgment of the Objects (presented to it from the inward Senses) so that the Will following the irregular Dictates of the Understanding, doth make ill Elections, as mis-governed by an erroneous guide.

The seat of a *Delirium*.

In a Brain well-disposed, the Animal Spirits make regular motions from the Origen of the Nerves, through the Interstices of their Filaments, making their progress through the several Processes of the Brain, in due manner and order, as instituted by nature; whence the outward and inward Senses, and the more intellectual Faculties do exercise regular Operations, in the true perception of outward and inward Objects.

The regular motion of the Animal Spirits.

But if the nervous Liquor, and its more agile, and more refined Particles, do make violent and tumultuary excursions through the various Filaments, relating to the fibrous Compage of the Brain; the thoughts of the Mind are rendred disturbed, and the outward and inward perceptions of Sense and

The irregular motion of the Animal Spirits.

Reason, confused and irregular, as not able to make right apprehensions of things.

The First
cause of a De-
lirium is in the
Blood.

If any one shall make an inquiry into the causes of these depraved operations of Sense and Reason, it may seem to proceed upon a double account, First, by reason of a fierce mass of Blood, having access to the Brain, by the inward Carotide Arteries; whereupon the Animal Spirits grow discomposed.

The Second
antecedent
cause of a De-
lirium.

The Second reason of a *Delirium* is from a depraved nervous Liquor, producing unquiet Animal Spirits.

The Blood is in fault by reason of an undue effervescence, caused by heterogeneous fermentative Particles, having an influence upon the Brain, or when the boiling Blood in the Paroxysms of intermittent or acute Fevers is carried in a great quantity into the Membranes of the Brain, (distending them) and compressing its fibrous Compag. Whereupon the Animal Spirits are acted with violent motions, between the spaces of the nervous Filaments.

The Third
cause of a De-
lirium may be
in the serous
part of the
Blood.

And the enraged Particles the Red Crassament of Blood do highly decompose the serous parts of it, out of which the nervous Liquor and Animal Spirits are generated; so that they grow very restless and impetuous in their motions, hither and thither, disquieting the Oeconomy of the Brain, and the Animal Functions of the common Sense, Phancy, Memory, Understanding, producing a *Delirium*, which is a depraved exercise of the operations of the said Faculties.

The Blood is also poisoned with malignant qualities (as in the Plague, Fevers, Small Pox) which act the Animal Spirits with enormous operations, disordering the rational and sensitive Faculties.

The Cure and
Medicines in
order to cure
a *Delirium*.

This distemper being of a short continuance, doth not denote any particular cure, as being a Symptome of acute Diseases, which being determined, a *Delirium* immediately disappears, and by reason the Animal Spirits are receptive of a great trouble and confusion in this disaffection, Cephalick Medicines may be advised in the form of Apozemes, Powders, Pills, Electuaries, to appease the fierce Particles of the Animal Liquor, apt to be hurried with violent and irregular motions; as also to strengthen the lax Compag of the Fibrils of the Brain, distended with the over-much elastick Particles of the Animal Liquor.

Another
course of Phy-
sick must be
prescribed, in
order to cure
a *Delirium*,
the conse-
quent of a
malignant Fe-
ver.

As to a *Delirium*, the consequent of an acute and malignant Fever, another method of Physick may be advised, as opening a Vein in a Plethorick Constitution; As also testaceous Powders, taken with Cephalick Julapes, which promote Sweat, and give an allay to the inordinate motion of the Animal Spirits, and the great effervescence of the Blood; To this end Topicks may be applied, as Epispastick Plaisters between the Shoulders, insides of the Arms, Thighs, Legs; As also Plaisters and Cataplasmes to the Feet.

A *Phrenitis* is
a high degree
of a *Delirium*.

Having discoursed a *Delirium*, which is a more gentle kind of desipience it may not be amiss to speak of a *Phrenitis*, as a more exalted degree of a *Delirium*, and a Disease more radicated in the Membranes and Substance of the Brain, proceeding from a fluctuation, and not from a more remis undulation of the Animal Liquor and Spirits.

The descripti-
on of a *Phre-
nitis*.

A Phrensy may be described a continued and lasting *Delirium*, with a depravation of the rational and sensitive Faculties, accompanied with a continued Fever, derived from the inflammation of the *Dura* and *Pia mater*, and from the great and inordinate motion of the nervous Liquor, very much expanding the Fibrils of the Brain; And from a hot distemper of the Brain, coming from bilious Matter, as *Sennertus* will have it.

The

The Essence of this Disease is found in an irregular motion of the Animal Spirits, the great Ministers of the more noble and inferior Functions of the Brain, and differeth in degree from a *Delirium*, as the Animal Liquor is more vitiated, and the Disease more rooted; as coming from more active causes, producing a rapid motion of the Animal Spirits in the Interstices of the Filaments (belonging to the fibrous Compage of the Brain) whereupon they grow more puffed up, and disordered by the expansive part of the nervous Liquor, dicomposing the fine Systemes of nervous Filaments, (constituting the admirable frame of the Brain) so that the Images of things, making apulses upon the Organs of the outward Senses, are imparted by a continuation of Nerves, to the common Sense, Phancy, and Memory, and are indistinctly apprehended, and after the same manner represented to the Understanding, whose confused Notions are offered to the Will, which is perverted in the elicit acts, by the ill conduct of the superior Faculty; whence flow incongruous Speeches, and ridiculous actions and postures of the Body, much repugnant to Reason and Sense.

The Essence
of this Di-
sease.

This Disease doth very much consist in a great ebullition of Blood, out of whose Albuminous Particles, the Animal Liquor is generated in the Cortical Glands, whence the Animal Spirits, the more active Atomes of the nervous Juyce, are acted with a *Phlogosis*, enraging the substance of the Brain, and its more noble parts the Animal Spirits, rendring them fierce and restless; whereupon the outward and inward Senses, and more excellent Faculties, are highly disordered.

A *Phrenitis*
consists in a
high Efferve-
scence of
the Blood.

Dr. *Willis* is of an Opinion, that a *Phrenitis* doth proceed from an inflammation of the Animal Spirits, and not from the coats of the Brain, as he hath it in the Tenth Chapter *De Delirio & Phrenitide*. P. 314, 315. *Enim vero probabile est sanguinem febriliter ardescens, particulas interdum sulphureas una cum spiritibus cerebro offundere; quæ semi accensæ, & quodam modo efflagrantes, si una cum alteris penetrarint, exinde mox omnes ductus Medullares & nervos subeuntes, spiritibus ubiq; adherent, adeoque omnes inflammatos, summe efferos, & implacabiles reddunt. Certe verisimilius est Phrenitida hoc ritu a spirituum Phlogosi potius, quam a meningum, aut cerebri inflammatione, quæ Cephalæam, aut Lethargum, certius quam furorem prout (ex cerebri anatomis compertum habui) inferrent excitari.*

But I humbly conceive (with the leave of this Learned Physician) That the Phrensie is not only deducible from an effervescence of the nervous Liquor, and Animal Spirits, but from an inflammation of the Membranes of the Brain, proceeding from an extravasated Blood, lodged in the Interstices of the Vessels, seated in the substance, belonging to the Membranes, encircling the ambient parts of the Brain, by reason the putrid indisposition of the Blood, affecting the integuments of the Brain, First indisposeth the Cortical Glands (in which the nervous Liquor is generated) as also the more inward penetrals of the Brain; whereupon the Animal Spirits are endued with an inflammatory disposition, highly disquieting their due motion, as rendring them turbulent and irregular, so that the lower and higher Faculties of the Brain cannot make due apprehensions of their objects presented unto them.

A *Phrenitis*
may proceed
not only
from an Efferve-
scence of
the Animal
Liquor and
Spirits, but
from an In-
flammation of
the Coats and
Brain it self.
The cause of
the Inflamma-
tory disposi-
tion of the Ani-
mal Spirits.

An Instance of this Hypothesis may be given, in which the *Pia mater* is often inflamed without the tumor of the substance of the Brain, as it hath been seen in Dissections of the Heads of Persons dying of Phrensies.

The *Pia mater*
may be infla-
med without
a Tumor of
the Brain.

A young Man of a lean and dry habit of Body, was afflicted with a continued Tertian, attended with ill Symptomes, as a great pain of the Head, proceeding from a hot and sharp mass of Blood, carried by the internal Carotide

rotide Artery into the substance relating to the Coats of the Brain, and was also tortured with most importunate watchings, and afterward in a small space of time the Patient was highly disordered with a *Phrenitis* (accompanied with horrid accidents, which could not be appeased with a proper course of Physick) and afterward died raging, with Red squallid Eyes; to the great disquiet of his Friends, and standers by.

After death, his Skull being taken off, the Brain was bespecked with Red spots, derived from extravasated Blood; And the Membranes, and especially the *Pia mater* was tumefied, being distended with blackish Blood, and the Branches transmitted through the substance of the Brain, did seem to be swelled and inflamed, which were imparted from the *Pia mater*.

A *Phrenitis* proceeding from an Ulcer of the *Dura mater*.

Sometimes the *Dura mater* is ulcered, accompanied with a fulness of Blood-vessels in the *Pia mater*, and an Abscess in the *Cerebellum*: Of this *Petrus Pauvius* giveth an account, *Observat. Octava Anatomica. Quidam per biennium conquestus fuerat de dolore in occipite, tandem hic Phrenitide ac convulsivis motibus correptus subito interiit; Huic crassa cerebri membrana aliquot locis exesa erat variis foraminibus, idque potissimum in bregmate sub sagittali sutura, ubi ea cum coronali jungitur. Ex iis foraminibus effluebat, & per membranam dictam effusus erat sanguis ferme concretus, ater & adustus, admodum fetens. Tali quoque sanguine distenta erant vasa per exteriorem crassæ meningis superficiem discurrentia, quin & ea quæ numerosa per tenuem disseminata sunt. Huic intra cerebellum, abscessus humore non naturali scatens repertus fuit: erat hic humor colore ex citrino ad pallidum vergens, pallida nimirum bilis. Ipsa cerebelli substantia flaccida omnino molliorq; multo quam cerebri substantia.*

A *Phrenitis* coming from an inflammation of the substance of the Brain.

A Phrensy also may come from an inflammatory disposition of the Brain, flowing from a quantity of bilious Blood, stagnant in the Interstices of the Vessels; whereupon the Animal Spirits are rendered obnoxious to a very hot affection, making them tumultuary in their motion, in their confused progress, between the Filaments of the nervous Fibrils, constituting the compage of the Brain; hence ariseth a *Phrenitis* from the Animal Spirits (enraged with hot steams of the extravasated Blood) which often degenerates into an Abscess, and Ulcer of the Brain. As *Nicholaus Fontanus* hath observed, *Analectorum cap. 1.* and mentioned by *Learned Bonnetus; Anatom. Pract. lib. 1. Sect. 7. De Phrenit. &c. Obs. 7. Pa. 163. Ad invisendum (ait ille) puerum duodecennem accersitus, arteriam in carpo contemplor duram cum pulsu frequenti & exiguo: ægrum imaginatione laborare deprehendo, Continuo delirantem, floccos carpentem, insomnem, immorigerum: Cui lingua exusta, fuliginosa, nigra: excrementa sicca, dura, pilularum instar: Hunc Phrenitide confirmata laborare, eaq; exitiali mihi persuasi: Nam triduo post, nullis auxiliis aptis proficientibus, migravit e vivis.*

Secto capite, contemplatoque cerebro, in ejus Medullari substantia repertus est tumor nucis juglandis magnitudine, rubidus, & venis turgentibus, sanguine repletus, quæ hujus noxæ fuit causa certissima: rupto abscessu, emanavit fetidus ichor, coclearis quantitate, & venæ jam ante tumidæ, subsederunt.

A Phrensy may be derived from an inflamed *Plexus Chorooides*.

A Phrensy may also take its rise from a quantity of watry Recrements, mixed with the mass of Blood in the *Plexus Chorooides*, and Ventricles; and also from thick Filaments of gross Blood (concreted in the *Sinus* of the *Dura mater*) somewhat resembling Worms.

An instance of this case.

A Woman oppressed with great sadness, upon an account of some great loss, fell into a burning Fever, accompanied with a great pain of the Head, which

which degenerated into a Phrensy, expressed in extravagant Singing, Laughing, and odd postures of the Body.

After death, her Skull being taken off, a thin pale Blood flowed out of the *Pia mater*; and the Ventricles of the Brain being opened, the Blood-vessels of the *Plexus Choroides*, and Chambers (in which they are lodged) appeared full of a watry Blood, and in the *Sinus* of the *Dura mater*, many gross Filaments were discovered, mad up of a gross Blood, mixed with crude unassimilated Chyle, of a Polypose nature.

A Phrensy doth not only come from extravasated Blood, but from serous Recrements too (secerned from the vital Liquor in the Cortical Glands) which pass through the *Cortex* into the more inward Processes of the Brain: These serous Recrements being hot and sharp, as compared with saline and hot steams of the Blood, do highly discompose the nervous Liquor, and its refined Particles, which being aggrieved with an over-elastick temper, do make turbulent and confused motions, very much puffing up the Filaments of the nervous Fibrils, productive of a Phrensy. Of this Learned *Webster* giveth an example, *Exercitat. De Apoplex. Historia. 4ta.*

J. Reutinger aliquot septimanis ante obitum crudelissime cephalalgia afflictus fuit; præ dolore quandoq, amens erat, ut quicquid vel diceret, vel faceret, non raro nesciret.

Mortui cranio aperto, & saucia dura meninge profluxit serum cum impetu, maxima ex parte collectum in spacio, quod inter duram & piam matrem est. Imo ipsa substantia cerebri & cerebelli plurimum serum imbiberat, nam summopere utrumq, erat flaccidum & molle.

Having spoke, after my manner, of the Essence, and various conjunct causes of a Phrensy, illustrated with the History of diverse Diseases of the Brain.

I will give you very short evident causes of this raging distemper, which raise a Feverish distemper, giving a fiery disposition to the Animal Spirits, caused by more freely indulging our selves in the large and frequent draughts of great bodied Wines, and other strong Liquors; as also immoderate passions of the Mind, and violent motion of the Body, and a suppression of the wonted evacuations of Blood by the *Menses*, or *Hæmorrhoids* bleeding through the Nostrils, &c. which render the mass of Blood very hot (especially in choleric Constitutions) which having a recourse by the internal Carotide Arteries, to the Membranes and substance of the Brain, do make fiery impressions upon the Animal Liquor and Spirits, rendring them over-active, and impetuous in motion, and over expansive, whereby the Filaments of the numerous Fibrils (besetting the Compag of the Brain) are disordered; so that the Organs of Reason and Sense being highly disaffected, the Superior and Inferior Faculties cannot perform their duty, in regular apprehensions of things, and due elections of proper means, in order to the preservation of Life and Happiness.

The Diagnosticks of this Disease, are troublesome watchings, accompanied sometimes with interrupted Sleep, and terrible Dreams; after which, Phrenetick persons make lamentable out-cries, biting their Tongues and Lips, and tearing their Cloaths, and breaking Glass-windows; and also do make frequent attempts to destroy themselves, by cutting their Throats, Drowning, Hanging, and casting themselves down Precipices: and in their fit of Raging, their Eyes and Faces are overspread with Redness, proceeding from a great quantity of enraged Blood, settled in the ambient parts of the Body.

A Phrensy proceeding from serous Recrements, vitiating the nervous Liquor.

An observation relating to the said Case.

The evident causes of a Phrensy.

The Diagnosticks.

The Prognosticks.

The Prognosticks of a Phrensy (as being an inflammation of the Membranes, or substance of the Brain) enraging the Animal Spirits, coming from the fiery parts of the Blood, or from an Abscess or Ulcer of the Brain, doth threaten great danger, often ending in death.

If this Disease afflict a good constitution of Body, abounding with a great quantity of Blood; or if it have often, and long intervals in a young person, the hopes of recovery are much greater, then in old age.

But if after moderate sleep, the raging Fits do more and more increase, it is an argument the Disease groweth more strong, and more dangerous, in reference to a new access of Morbifick Matter oppressing the Brain, and violating the nervous Liquor and Spirits.

A Phrenitis following an ill Crisis of a Fever.

If a Fever have a laudable Crisis by a free evacuation of Sweat, oftentimes the Phrensy is fairly determined; but if the Fever have an ill Crisis, the Matter of the Disease is transmitted from the lower apartment of the Body, by the Carotide Artery into the Coats and fibrous Compag of the Brain, making a *Phrenitis*, (which often appears in a pale water) and if the Pulse groweth low and quick, attended with a difficulty of Breathing, Vomittings, Convulsions, and frequent drops of Blood distilling out of the Nostrils, they are the symptoms or forerunners of death.

A Pleuresy degenerating in a Lethargy.

And if in a long continued Phrensy, the ambient parts of the Membranes, *Cortex*, and the *Corpus callosum*, be oppressed with a quantity of serous Recrements, or stagnant Blood, productive of an inflammatory disposition, it often degenerates into a Lethargy, *Mania*, *Melancholia*, or *Morosis*, which are hardly curable.

A Paraphrenitis proceedeth from an inflammation of the Midriff.

A *Paraphrenitis* is a Disease proceeding from an inflammation of the Midriff (accompanied with a Fever) which being endued with a multitude of nervous Fibrils, highly affecteth the Brain, as *Galen* and the Antients will have it: But the modern Physicians making a greater inspection into the nature of Diseases, gained by the dissection of dead Bodies, have found, that the Inflammation, Abscess, and Ulcer of the Midriff, have proved very fatal to Patients, without the least shew of a Phrensy.

A Paraphrenitis coming from an Abscess of the Midriff.

But I humbly conceive that a *Paraphrenitis* doth not come from an Inflammation, or Abscess of the Midriff, but is a gentle or bastard Phrensy, being near a kin to a *Delirium*, proceeding from slighter causes than a Phrensy, from a mass of Blood, not enraged with such high sulphureous Particles, or with serous Liquor, so much oppressing the *Cortex*, or more inward Recesses of the Brain; whereupon the Animal Spirits are less disordered, and the rational and sensitive Powers are not so much perverted in the performance of their operations, as in a Phrensy.

Bleeding proper in the cure of a Phrenitis, and Paraphrenitis.

As to the cure of the Phrensy, in reference to hot stagnated Blood in the Membranes, and substance of the Brain; it denotes Bleeding, to lessen the mass of Blood, and to make good its circulation.

Letting of Blood is most proper in the beginning of the Disease, while Nature is strong, and before the Disease is too much radicated in the state of it, when the Malady hath got a great head, attended with Syncopes, Lipothymies, and a quick weak Pulse, wherein it is more rational to forbear Bleeding, and apply Blistering plaisters between the Shoulders, to the inside of the Arms, Thighs, Legs, and Cephalick plaisters, and proper Cataplasmes to the Feet.

In reference to the Fever, accompanying the Phrensy, Emulsions made with cooling Seeds, may be proper to allay the unnatural heat of the Blood, which is often to be taken away out of the jugular Veins, or the Cephalick, Median, or Basilick of the Arm; as also a Vein may be opened in the Foot, when

when the *Menstrua* are suppressed, or Leeches may be applied to the Hæmorrhoidal Veins, which reveal the Blood from the Head, both in Men and Women.

Cupping-glasses may be applied to the Shoulders, and Neck, which very much relieve the Head in a Phrensy.

Cupping-glasses are proper in this Disease.

The temporal Artery may be safely opened in this Disease, as immediately discharging the fierce Blood out of the Carotide Artery, and proveth often very advantageous in this case.

Clysters also are very successful to empty the Bowels of Excrements and Wind; and Vomitings and Catharticks are very dangerous, except they be gentle, by reason they give great disturbance to the sharp and hot Humors of the Body, and much intend the Fever, which associates the Phrensy; Cephalick Julapes made of the Flowers of Lilly of the Vally, Limetree, Cowslips, and Red Poppy, made up with Pearl, and Sugar are very beneficial, to attemper the enraged Animal Spirits, which being fixed, are brought to a due order in motion, whereby the more excellent and meaner Faculties have a due perception of their various outward and inward Objects.

A Clyster may be very useful in a Phrensy.

Apozemes may be safely given, prepared with roots of Dogs-grass, wild *Asparagus*, *Bruscas*, and with the leaves of Vervain, Betony, fragrant Apples sliced, Corrants, the Seeds of Melons, Pumpions, White Poppy; and the Colature, after they have been boiled in water, may be dulcified with Syrup of Water-Lillies, of which a draught may be drunk after every Dose of an Electuary, prepared with the Conserve of Water-Lillies, Lime-Flowers, and Lillies of the Valley, Powder of the Four cooling Seeds, &c. made up with the Syrup of Water-Lillies.

Apozemes.

An Electuary of Conserve of Water-Lillies.

CHAP.

C H A P. LXVII.

Of Melancholy.

The Melancholy hath somewhat of likeness with a Phrenitis.

THis melancholick indisposition of the Brain, hath much affinity with a Phrenitis, as they are both delirious affections of the Head, flowing from vitiated Animal Spirits, disordering the upper and lower Faculties of Reason and Sense.

The description of Melancholy.

So that this Disease may admit this description, as being a Delirium composed of a depravation of Reason, and Imagination, accompanied with Fear and Sadness, which sheweth Melancholy to be a Malady, complicated with the indisposition of the Brain and Heart, by reason it is a Delirium proceeding from the Fault of the Brain and Animal Spirits, conjoynd with Passions arising from the Heart.

Melancholy differeth from other Cephalick Diseases.

This Disease differeth from a Phrenitis, Mania, Morosis, as it is a Delirium, associated with a high passionate discomposure of Fear and Grief; the sad concomitants of this Malady, of which the Patient can give a rational account, as not proceeding from any outward severe accident (producing these troublesome passions) but from an ill mass of Blood, and other ill inward causes, disturbing the Heart, Brain, and Animal Spirits.

The various Fancies of melancholick Persons.

And melancholick persons, are not only affected with clouds of Fear and Grief, but sport themselves in Laughter, and immoderate Joy, by pleasing their fancies with the vain apprehensions of great Honour and State, as being Kings and Princes, having a great affluence (as they conceive) of all Pleasures and Riches.

This Disease is styled Universal, or Particular, as it hath more or less Symptoms.

The ridiculous imaginations of this Disease have metamorphosed Men into Wolves, which they have endeavoured to imitate in Barking and Howling. Others have fancied themselves dead, and have intimated their desires to be buried, and have conceived their Bodies to be composed of Glass, fearing lest any person nearly approaching them, should rub upon them, and break them in pieces; it would be endless and infinite, to recount the numbers of foolish imaginations and nonsensical whimsies, accompanying Melancholy, which in reference to more or less symptoms, may be called Universal or Particular.

The First hath more numerous delirious apprehensions than the other, as treating themselves in sad, deep Thoughts, so that their fancy is restless, and sometimes entertaineth it self with variety of Objects, and other times with one (or a few things) of small importance, always running in the fancy, which they betray in speaking of it, to the great trouble of the Auditors. And also melancholick persons have objects represented to their fancy, under deformed, and uncouth large Images, which strike greater fear and terror into the Minds of this kind of delirious persons: These ill configured Phantasmes, being offered to the Understanding, confound its operations, and render the discourses of melancholick persons insignificant, and not agreeable to sound Reason.

And now it may be worth our inquiry, how the natural disposition of the Animal Spirits is perverted, which Learned Dr. Willis conceiveth to proceed from the fault of their peculiar Ingeny, as he hath it in the Eleventh Chapter De Melancholia, Pa. 323. *Hic autem primo inquirendam occurrit de Spirituum Animalium*

Animalium

Animalium diathesi, seu constitutione præternaturali: Nam in quantum isti, irregulari modo habentes, in anomalis suis aliquandiu aut semper persistunt; cumque huic illorum affectioni non Paralysis, Apoplexia, vertigo, aut convulsio adjunguntur, quæ Cerebri obstructions arguunt, inferre licebit, quod Spiritus Animales neq; ab alieno impetum faciente, in tales inordinationes adiguntur, neq; potissimum ob Cerebri poros, & meatus obstructos, suas concipiunt; sed potius in hoc casu propria indolis vitio prædicta symptomata agrotis accersunt. The Antients have conceived this disaffection of Animal Spirits to proceed from a Melancholick Humor, derived from adust Blood or Choler, rendring the refined and lucid Particles of the nervous Liquor cloudy; whereupon the Images of things have a dark representation, as if they were veiled with shades; and the Animal Spirits, taking their rise from inflamed Blood, do somewhat resemble the Rays of Light coming from a Flame, as Dr. Willis hath illustrated the different affections of Animal Spirits, by the various disposition of Light in the Chapter De Melancholia, Pa. 324. *At qui satis constat lucem se diversimode se habere, & illustrare, juxta quod ab incendio corporum vario ritu efflagrantium, scilicet spiritus vini, olei, sevi, sulphuris mineralis, nitri, aliorumq; procedit, pariter & Spiritus Animales, in quantum a sanguine crassim, modo hanc, modo illam, aliamve naçto, aut subtiles aut clari, aut hebetes, crassi, & quasi fuliginosi extillantur, functionum animalium organa varie trahunt, & irradiant, earumq; proinde actus diversimode pervertunt.*

The Opinion of the Antients concerning the disaffection of the Animal Spirits.

According to Dr. Willis, the different affections of Animal Spirits may be illustrated by the various disposition of Light.

And the Animal Spirits are not so free and loose in their Compage, as the Rays of Light, which are an innumerable company of lucid Atomes, moving with great quickness and agility, but the Animal Spirits are more confined, as engaged in the nervous Juyce, their proper vehicle, and may be compared to some chymical Liquors, drawn out of natural Bodies by distillation, which may illustrate delirious disaffections, as holding great Analogy with them.

Delirious dispositions may be illustrated by Chymical Liquor, extracted by Distillation.

Liquors Spagyrically extracted, are active Elements, which after various manners in them, are endued with a diverse Ingeny; and the most excellent Liquor, (as it is agreed by a common consent) is a Spirit espoused to Salt, which is volatified by it, and the Spirit again is fixed by Salt, which opposite principles speak a mutual advantage, as being ministerial to each others improvements; and the Spirits of Hartshorn, Soot, and Blood are impregnated with volatil Salts, which are very subtle, volatil, and penetrating, and yet are not inflammable; and the Animal Spirits being regular in motion, as endued with a laudable constitution, somewhat resemble a Spirituous Liquor, exalted with volatil Salt, extracted out of Blood by distillation, except the great Acrimony, and Empyreuma of Spirituous distilled Liquor, coming from the Fire: The Animal Spirits have a different mild disposition, as extracted out of the albuminous parts of the Blood by a more mild heat,

Liquors impregnated with volatil Salt.

But other chymical Liquors, being endued with a sulphureous nature (as Spirit of Wine and Turpentine, consisting of oily, and spirituous parts united) are easily inflammable, they are parted from each other by Fire; of this disposition (as Dr. Willis conceiveth) are the Animal Spirits, producing a Phrensy.

Liquors endued with oily and spirituous Particles.

But other different Liquors, Chymically extracted (in which fixed Salt brought to a fluor, is predominant) and distilled by a gentle Fire out of Vinegar, heavy Wood, and some kind of Minerals; have very restless Spirits, whose *Effluvia* cannot extend themselves far.

The continent
cause of a me-
lancholick af-
fection.
The antecede-
dent cause of
this Disease
cometh from
the serous
parts of the
Blood turning
Acide.

And if they be distilled in B. M. nothing but Phlegme can be extract-
ed: And the Animal Spirits being tainted with an acide Affection, proceed-
ing from fixed Salt (brought to a Fluor) hath a great share in the produ-
ction of Melancholick affections; so that I humbly conceive, that the antecede-
dent, and causes of this Disease, do come from the serous parts of the Blood,
(carried by the Carotide Arteries of the Cortical Glands, and other Proces-
ses of the Brain) degenerating from a mild into an acide and corroding dis-
position (somewhat akin to Vinegar, Alome, Vitriol, &c.) which doth vi-
tiate the nervous Liquor, and its more exalted Particles, vulgarly called the
Animal Spirits, and disturb their regular motion, rendring them restless and
confused.

Whereupon followeth a depravation of the Superior and Inferior faculties
of the Brain, causing a Delirium, attending Melancholy.

And it may be farther observed, that steams flowing from acide Liquor,
are always in motion; by reason the Spirit of Vinegar, Vitriol, Sea-Salt, do
perpetually evaporate, as the Particles of fluid Salt, have no coherence with
heterogeneous Particles, and are always restless in their nature, and in perpet-
ual motion.

The Acide
Spirits of Ve-
getables do
resemble the
Acide serous
parts of the
Blood, deba-
sing the Ani-
mal Liquor
and Spirits.

Whereupon we may suppose with great probability, that the acide
Spirits of Vegetables and Minerals (put into a Glass Hermetically sealed)
have their steams carried about the sides of the Glass in a circular motion,
and do very much resemble the serous parts of the Blood, depressed with
fixed Salt, and Vitriolick Atomes, debasing the nervous Liquor, the Vehicle,
and subject of Animal Spirits, which are rendred unquiet, in their passage
by the sides of the Filaments, constituting the Fibrils of the Brain. Hence
flow constant and troublesome Thoughts, that discompose the Fancy, and
the rational and sensitive Faculties, as the Animal Spirits are composed of
acide, unquiet Particles, which do not duly actuate, and irradiate the ner-
vous Compage of the Brain.

Out of the acide Spirit, Chymically prepared, the Effluvia do not highly
ascend beyond the surface of the Liquors, and only accoast the adjacent
Bodies, and make no approach to those that are seated at a distance; so that
the Spirit of Vitriol, Salt, or Vinegar cannot ascend out of the Still to the
top of the Alembick, unless it be forced up by an intense heat.

The cause and
manner how
Melancholy
operates.

After this manner the phantasmes of Melancholick persons (afflicted with
adust Choler) proceeding from Animal Spirits, degenerating into an acide
disposition, do influence the whole Compage of the Brain, and act in the
Meditullium, and are carried into the spaces of the neighbouring Filaments,
where the Animal Spirits exert their motions in a confused manner; whence
Thoughts perpetually arise, which are much versed about one, or but a few
objects: And when a great number of Spirits are confined within a narrow
compass of the fibrous Compage of the Brain, the phantasmes are very much
enlarged beyond the true dimensions, and small things rendred great; and
after the like manner, when the visible images of things are represented by a
Microscope, they appeart much greater, then they are in their own nature;
as the many Rays are united and concentred in a Convexe Glass; so also the
intentional species are configured in the Fibrous Compage of the Brain, by the
conflux of many Animal Spirits, confined within a small circumference. Of
this we may have an Experiment in our Selves, when we are fed with gross
melancholly Diet, or being clouded with the passion of sadness, we become
Thoughtful, by reason the Animal Spirits do want a free Emanation, we
are made sollicitous of every small concern, as if our whole happiness de-
pended

pended upon it. Whereupon we are discomposed with great Fear and Anxiety, conceiving our selves utterly lost in our vain apprehension, when we are overcome with Melancholy

And this melancholick Affection doth not only take its rise from an acide disposition, spoiling the Crasis of the Animal Spirits, but from an atrabilarian Humor, carried with the Blood by the internal carotide Arteries, into the substance of the Cortical Glands; whereupon their nature is much debased, and as losing their sweet temper, and volatil saline disposition, their Compage is rendred more gross and opaque; so that it cannot be duly enlightened by the lucid Particles of the Animal Spirits

Melancholy
coming from
an atrabilari-
an Humor.

And Melancholy is not only contracted by the fault of the Brain, and Animal Spirits, but from the *Præcordia*, and from the Blood, endued with heterogeneous Particles, highly fermenting in the noble parts of the middle Apartment, and thence transmitted by arterial Channels into the Brain, where it maketh a great alteration in the nervous Compage, as it is affected with gross atrabilarian Particles, perverting the Crasis of the Brain, and clouding the bright Ingeny of the Animal Spirits.

Melancholy
flowing from
the *Præcordia*
and Blood.

The Humors proceeding from adust Choler, do much lessen the purity of the flame of Life, in taking off much of its Activity and Spirit; whereupon it moveth more slowly in its various Channels, and contracteth gross Recrements, associated with the Blood, out of whose more mild parts, debased by atrabilarian Humors (producing grief and fear, ill companions) the purity of the Animal Liquor and Spirits is very much sullied, often generating a sad Delirium.

The ill temper of the vital Liquor causing this timerous Disease, doth partly proceed from undue fermentation of the Blood in the Heart, whereupon it groweth less oily and bountiful in its spirituous parts, proceeding from too much exalted saline Atomes, rendring the Blood gross and unactive; whereupon the Blood (transmitted out of the right Chamber of the Heart into the pulmonary Artery and substance of the Lungs) as being too much burdened with fixed Salt, cannot be duly attenuated and inspired with the elastick particles of Air; so that we grow faint and sorrowful, as our Blood wanteth a due intestine motion in the Heart and Lungs; whereupon it groweth depressed in this Malady, as overcharged with gross, saline, and sulphureous Particles; whereupon arise variety of passions in the Heart, as Fear, Sorrow, Faintness, and panting in the most noble machine of motion, which doth not only suffer by the ill crasis of the Blood, clogged with ill, effate, adust Choler, and saline parts, but the vital Liquor also is very much retarded, as growing degenerate for want of a due circulation through all the apartments of the body, which is produced in this Disease by a slow and weak motion of the Heart, coming from its disabled contractions of muscular Fibres, caused by the defect of Animal Spirits, not sufficiently acting the Nerves; so that the Blood and Animal Spirits do disaffect and prejudice each other; the atrabilarian Blood, as affected with saline parts, produceth gross Animal Liquor and Spirits; and again, the Animal Spirits being endued with an ill disposition, do not duly influence the Cardiack Nerves; whereupon the Blood, and Animal Spirits do pervert each others Crasis, in reference to purity, vigor, and activity.

The temper
of the Blood
producing a
timerous dis-
position.

The inordinate passions of the Mind, as vehement love, sadness, panick fear, envy, malice, do very much disturb the œconomy of the Brain, and spoil the nervous Liquor, and Animal Spirits, in forcing them to run excentrick, in reference to their common Sphæres of the Interstices of nervous Filaments,

Vehement
Love discom-
poseth the fine
temper of the
Brain.

laments, by making them depart into the Pores and *Meatus* of the substance of the Brain; whence proceedeth the depravation of the various Faculties Trust and Reason residing in it.

The Indisposition of the Blood proceeding from crude Chyme not well assimilated.

Again, the Blood acquiring an undue Crasis, as being mixed with a Chyme, not broken into small Particles, by the faint motion of the Heart, as in Fear, Sadness, &c. doth render the vital Liquor crude, and full of fixed saline Particles, as not well attenuated by the motion of Blood, coming from the weak contractions of the fleshy Fibres of the Heart; whereupon the ill-affected Blood doth make, or spoil the production of laudable Animal Liquor and Spirits in the cortical Glands of the Brain.

The Blood is distempered by violent exercise.

The Blood also contracteth an ill temper by immoderate Exercise, gross Diet, of Salt Meats, especially if they be dried in Smoke; and the suppression of accustomed evacuations of Blood, by the Hemorrhoids and *Menstrua*, bleeding at Nose, and of purging the serous Recrements, by Vomiting and Stool, all which do infect the Blood and render it Atrabiliarian, which afterward indisposeth the nervous Liquor, and Animal Spirits.

The Antients did conceive the first rise of Melancholy to be seated in the Brain, and other times in the *Uterus* and Spleen; as to the Brain it may be called *Idiotia*, when the Brain hath its substance habitually vitiated by an ill nervous Liquor, primarily flowing from the ill serous Liquor of the Blood, out of which it is formed.

Some conceive the seat of Melancholy to be in the Womb.

Others do imagine the seat of Melancholy to be in the Womb, which is very improper, seeing the Atrabiliarian Humor is not first generated in the Womb, which is only occasional, in point of an ill mass of Blood, produced by the suppressed purgation of the *Menses*; whereupon the vital Liquor groweth degenerate, as being depressed with gross saline and sulphureous Particles, which being associated with the Blood, (imparted by the carotide Artery into the substance of the cortical Glands) doth make an ill nervous Liquor, the vehicle and ground of the Animal Spirits.

The Spleen by divers is apprehended to be the subject of Atrabiliarian Humors.

And as to the Spleen it is vulgarly apprehended to be the subject of the Atrabiliarian Humors, commonly called Hypochondriacal Melancholy, by reason of the Blood, being filled with many *Feces*, is not depurated in the Glands of the Spleen; whereupon the Ferments of the Blood are spoiled, and being carried with it into the substance of the Brain, doth produce an impure Animal Liquor, vitiating its more volatil Particles (commonly styled Spirits) causing a melancholick distemper.

Sometimes this sad Disease is conceived to be propagated from all the apartments of the Body, as in a Scorbutick habit, wherein the mass of Blood hath lost its tone, and bounty, as being tainted with gross, saline, and sulphureous parts, which are not severed from the vital Liquor, in the various colatories of Blood, the Spleen, Liver, Kidneys, consisting of numerous Glands, the systems of innumerable and various vessels, the secretories of the vital Liquor, from several kinds of Recrements (especially as being saline and sulphureous) which being not separated from the mass of Blood, have a recourse to the Brain, and defeat the production of good nervous Liquor and Spirits, the ground of this Atrabiliarian Malady.

This Disease sometimes proceeds from a sanious Matter in the Left Ventricle of the Heart. An observation according to the said Case.

This Disease sometimes ariseth from a sanious and mucous Matter in the Left Ventricle of the Heart, and from the Gangreen of the Liver and Spleen, and from the jugular Veins, full of adust black Blood.

A Servant of a Merchant labouring under a melancholick affection, was so afflicted with a deep sadness, that she perpetually wished for death, always treating her self with Sighs and Tears.

After

After death, the Head being opened, and the Coats taken off, the veins of the Brain appeared full of black Blood, and the Right Ventricle of the Brain was discovered to be stuffed with Blood, made up of many concreted Filaments; and in the Left Ventricle was lodged a quantity of sanious, mucous Matter; And afterward the *Thorax* being opened, and the Heart Dissected, a quantity of black Blood gushed out; and the Lobes of the Lungs were livide, and being opened, a sanious corrupt Matter distilled out of their substance. And the lower Apartment being laid open, the convex part of the Liver was discoloured with a livide hue, and the middle of the Spleen was defaced with a blewish colour about the surface, and its more Interior Recesses being inspected, were found to be of a laudable colour and substance.

This dreadful Malady sometimes proceedeth from black corrupt Humors, lodged in the bosom of the Stomach, attended with a *Scirrhus* of the *Pylorus*, and a *Scirrhus* of the Mesentery, of which, some part is concreted into a hard strong substance.

Melancholy
sometimes
cometh from
corrupt Hu-
mors in the
Stomach.

An Instance of
this Case.

A person of Honour being endued with a cholerick Constitution, and of a thin habit of Body, found a great weight in the bottom of his Stomach, attended with fætid Belchings, and much *Flatus*, making a noise in its passage found the Intestines, and distensions of the Hypochondres, accompanied with great Fear and Sadness, and deep Thoughts, and a weakness of the Animal Faculty; and after a proper course of Physick had been administered, to satisfy all Indications according to Art, nothing proved successful in this desperate Disease.

And after he had yielded to Fate, his Body being Dissected, and the distended Stomach being opened, in the bottom of it was seen a black corrupt Matter, resembling Ink, and the *Pylorus* was found to be *Scirrhus*, shutting up the passage out of the Ventricle into the Guts. And the Mesentery was discerned to be also *Scirrhus*; and some part of it was concreted by a *lapidescente* Juyce, into a hard Matter somewhat like Stone.

And a melancholick distemper of the Brain may take its rise from menstruous Blood (debased by gross saline and sulphureous Particles) when the natural Channels are stopped in the *Uterus*, so that it cannot be discharged monthly by the Cavity of the Body and *Vagina* of the Womb; so that the terminations of the Spermatick and Hypogastrick Arteries, carrying Blood into the substance of the *Uterus*, and the secret *Meatus*, leading into the bosom of the Womb being obstructed, the vital Liquor is received into the Spermatick, and Hypogastrick Veins, and transmitted through the ascendent Trunk of the *Vena Cava*, into the Right Ventricle of the Heart, and from thence through the Blood-vessels of the Lungs, into the Left Chamber of the Heart, and conveyed afterward through the common and ascendent Trunk of the *Aorta*, and Carotide Arteries, into the substance of the Cortical Glands; wherein the Blood (tainted with a fermentative and Atrabiliarian Disposition, and not discharged by the *Uterus*) doth take off the purity of the nervous Liquor, and Animal Spirits, and deprave the upper and lower Animal Functions, often attended with deep, sad, and despairing imaginations, highly torturing the unquiet minds of Patients, as fancying themselves Eternally unhappy.

Melancholy
flowing from
the obstructi-
on of the
Uterus.

An Instance may be given of this case, in a Gentlewoman (committed to my care) of a Sanguine Constitution, who walking in the Fields, presently after a free evacuation by Sweat, was surprized with cold blasts of Wind shutting up the cutaneous Pores, and stopping her *Menstrua*, which were then in motion; whereupon the ill-affected Blood had a recourse to the

Heart, producing great Fears, and despairing Thoughts, and quick pulsations; and afterward the Attribilarian Blood being impelled by the Carotide Arteries into the substance of the Brain, did infect the Liquor and Spirits with saline and sulphureous Atomes, and pervert the operations of her imagination, Memory, and Reason, accompanied with dreadful passions, rendering her most unquiet in the sad apprehensions of infernal fire and pains, which all cease upon repeated Bleeding in the Foot, and by application of Leeches to the Hæmorrhoidal Veins, and a course of cordial and cephalick Medicines, perfectly restoring her by Gods assistance and blessing, to the former use of all the Faculties of her reason, and inward and outward Senses, to the great joy and satisfaction of her Friends and Relations, and the Glory of the All-Wise and Sovereign Physician of Body and Soul.

The cure of Melancholy is in a great part effected by the defæcation of the Blood.

As to the cure of Melancholy in a general notion, in reference to its antecedent cause, it indicates the depuration of the Blood by making it good, clear, and volatil, by taking away its gross, sulphureous, and saline Particles, whis is effected by opening the obstructions of the Liver, Spleen, Kidneys, and *Uterus*, whose various substance are different Systemes of numerous Glands, the several Colatories of the Blood.

And as to the discomposure of the Mind, having great influence upon the Vital and Animal Liquor and Spirits, we are to divert the passions of Sorrow and Fear, attended with Cares and deep Thoughts, with pleasant company, and ingenious and merry Discourses, and Thoughts, by rendering them free and easy; and by telling the Patient the causes of his dreadful apprehensions are removed; wherupon the Melancholy immediately disappears.

Trallianus giveth an account of a Physician who fancied his Head to be cut off; whereupon a Leaden Cap being ordered to be put upon his Head; he felt the weight of the Lead, which gave him the Sense of his Head, and cured his vain fancy.

Another Patient imagined he had Frogs croking in his Belly, which was the noise of Wind passing up and down his Bowels; and was cured by Purgatives, making great evacuations of Excrements into a Close stool, wherein the Physician advised Frogsto be cast, and desired the Patient to view the Frogs swimming in the Excrements, which took away his melancholy apprehension of Frogs in his Belly. I could add many more such instances of this Disease, and their Cures, but I will omit the trouble.

A good Diet is proper for the cure of this Disease.

And the cause of this Disease being an ill mass of Blood (clogged with gross, adust, and saline Recrements) a good Diet may be advised to render it laudable, as Meats of good nourishment, of a moist temper, of a thin substance, and easy digestion, and not flatulent, as the flesh of Chickens, Pullets, Capons, Partridges, Lamb, Mutton, Veal, &c. Of Fish, Whittings, Perch, Flounders, Gudgeons, and of new laid Eggs, boiled or roasted rear. Of Herbs, Borage, Bugloss, Lettuce, Endive, Spinach; Of Fruits, Figs, Almonds, Pineæ, Pistachia, Corants: As also in this Disease, Suppings are beneficial, as endued with a cooling and moist temper, which do temperate and moisten, and dissolve sulphureous and saline Recrements, such as Water-gruel, Barley-gruel, Barley-cream; thin Broths made with Oatmeal, Barley, and cooling and moistning Herbs.

All salt and smoked Meats is bad in melancholy distempers.

And on the other side, all gross, Salt, and smoaked Flesh must be forborn, as Beef, Pork, Goat, Hare; And of Fowls, chiefly Geese, Ducks; Of Fish, Salmon, Skaite, Thornback, Sturgeon, and all other gross Fish hard of digestion; And of Herbs, Cabbage, Coleworts, Colly-Flowers, and the like.

And

And above all, a thin and temperate Air is to be chosen, which attenuates, cooleth, and moisteneth the Blood, and taketh off its dry, saline, and hot and gross sulphureous Particles, and restoreth it to its bounty and purity.

The cure of Melancholy is of as great difficulty, as importance, in reference to its many evident, procatartick, and continent causes, attended with many, and dreadful symptomes; whereupon the remedies, and method of Physick do admit great variation.

The cure of Melancholy is very difficult.

The evident causes consisting in the passions of the Mind, are to be allayed by all means imaginable, as sorrow by a pleasant converse, and indignation, and anger by excellent precepts of meekness and humility, which sometimes do appease the immoderate passions of the Mind; And a good Counsel of a Spiritual guide, and intimate Friends, do often take off vain scruples in Spiritual Matters, and calm the great storms of afflicted, wounded, and despairing Souls, that the bones which God hath broken, may rejoyce.

The way to cure the passions of the Mind.

The Therapeutick method in this Disease, doth offer us Three Indications, the Curatory relates to the Disease and its continent cause, the Preservatory, consisting in the Procatartick, and evident causes, and the Vital, which is founded *Viribus conservandis*.

As to the Disease, which is chiefly caused by an ill *Succus nervosus*, and clouded Animal Spirits proceeding from acide, and fixed saline Particles of the Blood, spoiling the purity of the Spirits of the Brain; it doth indicate proper Antiscorbutick Medicines, prepared with Garden and Sea Scorby-grass, Brooklime, Water-cresses, Pine, Firr, mixed with Millepedes in the distillation of Milk, Mum, &c. or prepared by way of the said Juices of Plants mixed with that of Oranges, which refineth, and giveth them a pleasant Taste. As also Antescorbutick Syrupes, or Conserves, made up with Powder of Steel, prepared with Sulphure, are beneficial in this Disease, as they depurate the ferous parts of the Blood, the *Materia substrata* of Animal Liquor and Spirits.

The acide disposition of the nervous Liquor, is much corrected by Antescorbuticks.

Chalybeats are proper in this Disease.

And in reference to the preservatory Indication, by taking away the antecedent cause, founded in the quantity of ill Blood, a Clyster may be premised, and a Vein freely opened; as also Leeches may be applyed to the Hemorrhoids to divert the Blood, and to produce a natural evacuation by those vessels from the Head, and the *Saphena* is proper to be opened in Women, labouring with the suppression of the *Menstrua*. As also a proper method of Physick may be given before propounded in the diseases of the *Uterus*, in order to purge the Blood of its grossness, and to open the obstructed Blood-vessels of the Womb. Vomitories also prove very advantageous in melancholy (affecting the Brain) as emptying a foul Stomach of gross Phlegme (which is viscous indigested Chyle, adhering to the inward coat of the Ventricle) and other acide Recrements, which spoil, or weaken, at least the concoctive faculty of the Stomach, making an ill Chyle: Vomitories also very much refine the Blood, by opening the Cystick and Choledock Ducts; and that of the *Pancreas*; whereupon various kinds of Recrements are discharged into the Guts: In strong Bodies, Oxymel of Squills, Wine of Squills, mixed with some few grains of White Hellebore, may be given in *Carduus* Posset-drink, and frequent draughts of it during the time of Vomiting. As also an infusion of *Crocus metallorum*, or Emetick Tartar of Mynsichte, or Salt of Vitriol, or Sulphure of Antimony. Purgatives are celebrated with good success in this Disease, as discharging gross, acide, and saline Recrements of the Blood, except they be strong, which give great annoyance to the Body, as increasing the fermentation of ill Humors, and weakening the *Tone* of the Blood, and vitiating the nervous Liquor, and Animal Spirits,

A Vein may be freely opened in a melancholly disposition, labouring of much Blood. Leeches may be also applyed to the *Anus*. A proper course of Physick must be used in the obstruction of the *Uterus*.

Vomitories are good to refine the Blood. Purgatives are proper in this Disease.

often

Cooling and
moist Medi-
cines are use-
ful in a Melan-
cholic di-
stemper.

Purging Pills.

Purgative
Powders gi-
ven in Posset-
drink.

Benigne Pur-
gatives are
most laudable
in this Disease.

Testaceous
Powders gi-
ven in some
proper Apo-
zemes, or in
clarified
Whey.

The vital In-
dication de-
notes Medi-
cines corobo-
rating the
Brain.
A Cephalick
Electuary.

A Cephalick
Julape.

often accompanied with Convulsive motions. Whereupon I most humbly conceive it most agreeable to Reason in this Disease, to advise gentle Purgatives, prepared with proper alteratives, at once purging of the Atrabiliar Humors, and giving alay to the other, by cooling and moist Medicines, which do countermand the hot and dry disposition, and sweeten the acide and saline parts of the Blood; As the root of Polypode of the Oak, Epithymum, Caruway seed, boiled in water, with a little Wine, Senna, Rubarb, Agarick, Tamarinds, adding at last a purging Syrupe of Apples, or Syrupe of Peach-Flowers, &c.

Pilula Tartarea Bontii, Quercetani, de succino, quickned with a little Refine of Jalape, or Scammony, or Extract of *Rudius*, Tartar vitriolated, and in strong constitutions of Body, Extract of black Hellebore, Gum Ammoniac dissolved in Cinnamon-water, Refine of Scammony, Jalape, &c. may be advised,

Purgative Powders, as *Diasema, Diaturbeth*; as also Rubarb, Agarick, Senna, *Lapis-lazuli*, powdered and given in Posset-drink, prepared with Small Beer, and White-wine, in which you may add Syrupe of Apples, Syrupe of Roses-solutive, of Peach-Flowers, of Buckthorn, &c.

Purgatives may be advised frequently once in Five or Six days, and let them be prepared with benigne Medicines, which do not offer a violence to Nature; by reason strong Medicines have a malignant temper, which do irritate the ill Humors of the Blood, and vitiate it and the nervous Liquor, and give an irregular motion to the Animal Spirits, and aggravate the Disease; If the Body be bound, a Clyster may be injected of a common decoction, prepared with some gentle purging Electuary, or rather with purging Syrupes and common Sugar.

Testaceous Powders, made of Crabs claws, Egg shels, &c. and of Pearl, Coral, Crabs Eyes, and the like, may be given in Posset-drink, or Whey, or some alterative Apozeme, prepared with some of the Five opening Roots, of the Leaves of Borage, Betony, the Flowers of Cowslips, Water-Lilies, Ivory shavings, Pippins, Raisins of the Sun, &c. and sweetned with Syrupe of Cowslips, or Water-Lilies, to which may be added some compound Briony, or Pæony water.

Decoctions of *China, Sarza*, in which may be infused the tops of Pine and Firr, the Flowers of Cowslips, Water-Lilies, Borage, Bugloss, and being strained, may be sweetned with the alterative Syrupe of Apples, Water-Lilies, Cowslips, Wood-Sorrel, and the like, which do temperate and moisten the hot and dry temper of melancholic Persons, and dulcify the saline parts of the Blood, which are a main ingredient in this disconsolate, phanciful Disease.

The Third Indication, being vital, doth consist in the conservation of the affected parts, and doth denote corroborating Medicines, which do strengthen the Brain, and repair the decays of Nature.

In this case Electuaries may be proper, made of the Conserves of Lime-Flowers, Lily of the Valley, Water-Lilies, Cowslips, Gilly-Flowers, the Powders of Pearl, Crabs Eyes, Crabs Claws, Coral, Candid Rine of Citron, or Mirabolans, to which Syrupe of Water-Lilies may be added to make it into the consistence of an Electuary,

After which may be drank a draught of Cephalick Julape, made with the distilled Waters of Lime-Flowers, Lillie of the Valley, Black Cherries, compound Pæony, sweetned with Syrupe of Cowslips, Water-Lilies.

In

In this case a Magistral distilled Water may be very advantageous. Take A Cephalick distilled Water. of the Leaves of Betony, Borage, Bugloss, Water-creffes, Brooklime, Balm, of the Flowers of Cowslips, Water-Lilies, Lily of the Valley, of the chips of Citrons, Auranges, Limons, Nutmegs, distilled in Whey, made with fragrant Apples, to which may be added a little White-wine.

Apozemes also are useful in Melancholy, prepared with the Roots An Apozeme. and Leaves of Polypode of the Oak, Hartshorn, Ceterack, Epithymum, Water-Germander, Water-Cresses, and Millepedes bruised, of which some may be boiled in a close Pipkin, and being strained may be sweetened with double or treble refined Sugar.

After a Chalybeate course, the Waters of *Epsam*, *Barnet*, *Northal*, or *Dulige*, may be drank, as preparatory to the Waters of *Tunbridge*, *Rotherfield*, The purging Mineral Waters. (as good as any of the *Acidulæ*) or the Spaw-waters of *York-shire*, which The diuretick Waters, are to be taken with a proper method of Physick, else they may prove very prejudicial.

Whey also may be very beneficial, prepared with the tops of Pine and Firr, or with Brooklime, Water-Cresses, the Flowers of Cow-slips, Lime, Lily of the Valley, Water-Lilies, &c.

Broths also may be given, made with a Chicken, or Pullet, and with the A Medicinal Broth. Leaves of Polypode of the Oak, Wood-Sorrel, or with Borage, Bugloss, Pearl Barley, to which may be added the Shavings of Hartshorn, and Ivory.

CHAP. LXVIII.

Of a Mania, or Madness.

Madness is
near akin to
Melancholy.

THE *Mania*, or Madness hath much affinity with Melancholy, and degenerates into Madness, as the Atrabiliarian Humor groweth more exalted, and mixed with acide Recrements, it is turned into a Maniack disposition, and the Vital Spirits being highly enflamed, do enrage the Animal, productive of Madness, which attendeth Melancholy, as the flame is ushered in by Smoak.

The definition
of Madness.

This Disease may be defined, a *Delirium*, or depravation of the Imagination and Reason (without Fear and Sadness, the attendants of Melancholy) with fury, boldness, and great clamors, and rantings, derived from saline, sulphureous Particles, arising first out of the Blood, and afterward imparted to the Animal Liquor and Spirits.

Madness sup-
posed to be an
elevated Me-
lancholy.

Some Physicians suppose Madness to be an elevated Melancholy, as the saline sulphureous Particles, of the Atrabiliarian Humor, are only more exalted, producing more symptoms of Rage, boldness, horrid out-crys, &c. But I humbly conceive, this Disease doth not differ gradually, but specifically, as coming from various causes, and accompanied with higher symptoms, by reason Melancholy is accompanied with Fear and Sorrow, and Madness with Fury and Boldness, flowing from nitro-sulphureous parts of the vital Liquor, making a hot Fermentative disposition of the nervous Juyce, enraging the Animal Spirits.

The subject of
Madness.

The subject of this Disease is the fibrous Compag of the Brain, composed of numerous Fibrils, containing the nervous Liquor (generated of albuminous parts of the Blood) the subject and vehicle of the Animal Spirits, which move between the Filaments of minute Nerves, in a great hurry, and most irregular manner.

The symp-
tomes of Mad-
ness.

The turbulent symptoms of this furious malady, is a depravation of the phancy and intellect, importuned with storms of impetuous Thoughts, expressed in furious Language, and ranting Gestures, of tearing Cloaths, biting the Tongue, and offering violent hands to themselves.

Symptoms of
this Disease
are illustrated
by Mineral
Waters.

These horrid Signs, arising out of the ill tone of the Animal Spirits, Dr. Willis illustrates by Mineral Waters, Cap. 12. De Mania, Pag. 345.

Primo Aquæ Stygiæ particula summe agiles, & irrequietæ in motu perpetuo existunt, hinc ut effluvia aliis decedentia nares continuo feriant, atq; liquor e vase effusus corporibus quibusq; aliis occurrens, valde effervescat, eorumq; poros & meatus penetrat; cujus ratio est, quod particula salina sulphureis Conjunctæ, seinvicem exagitant cumq; nullis alias generis cohærent; pariter opinari licet Spiritus Animales e sanguine uberiori, & quasi nitro sulphureo extillatos, insigni mobilitate sive inquietudine præditos esse, qui proinde e cerebri meditullio quaquaver- sus tum in ambitum ejus, tum in systema nervosum expansi, indeque perpetim reflexi, phantasmata efferata, & fere nunquam interrupta, atq; functionis tam sensitivæ, tum locomotivæ inordinationes maximas, & perpetuas producunt.

The steams exhaling out of the nitrous Spirits of Mineral Liquors, do not arise out of free, and open Pores, but do form new Meatus, and perforate Bodies upon which they have an influx, and render them feeble, and turn them into

into innumerable Atomes, which is most evident in the solution of Metals, caused by proper *Menstrua*, impregnated with nitrous and vitriolick Salts, which emit innumerable restless *Effluvia*, making troublesome Appulses upon the nervous Fibrils, seated in the inward Membrane, encircling the inside of the Nostrils; and somewhat in a Maniack Disease, the disposition of the Animal Spirits (being infected with the steams and ill Liquor of the Blood) are rendred very impetuous in their motion, making many new Tracts in the Brain between the nervous Fibrils, receding from the common road of the Animal Spirits; whereupon they wander and produce absurd Conceptions in the understanding and phancy, and make incongruous enunciations, by compounding things present with things past and to come, and confounding right notions by their disorderly conjunction, with opposite and contrary sentiments.

And it may be observed, that many vaporous minute Atomes, arising out of nitro-sulphureous Spirits, do not confine themselves within narrow bounds, (as steams ascending out of acide Liquors) but do diffuse themselves every way at a distance, which may be easily experimented, when Spirit of Nitre is embodied with Butire of Antimony; whereupon the whole room may be infected with a Black Fume, arising out of those stygian Liquors; or when *Aqua-fortis*, or Spirit of Nitre doth ascend out of the Alembick, a most sharp vapour being diffused from thence, doth affect the Nostrils and Lungs seated at a distance, which happens by the various Particles of fluide Salt, and fierce Sulphure, espousing each other, which do exalt these different Elements, and promote their activity at a distance, by making them to expatiate themselves to a remote Sphære, in which they briskly exert their operations,

After the same method the Animal Spirits seem to deport themselves in Mad persons, as Dr. Willis hath observed; *Pari equidem modo circa Spiritus Animales in Maniacis habere videtur, qui siquidem ejusdem, ac aquæ stygiæ indolis fuerint, idcirco tum cerebri Compagem, tum appendicem citissime trajicientes, affectos non tantum furiosos, sed velut Dæmoniacos efficiunt; adeo ut metum aut languore quoq; immunes quodvis audaciter aggrediantur, sese intrepidus objiciunt, etiam ob prodigiosas Spirituum exertiones robore immani polleant, vincula & Catenas sæpe disrumpant, atq; viros fortissimos iis obstantes, & coercere nitentes simul plures debellant.*

The manner how the Animal Spirits move in mad persons.

Whereupon the Animal Spirits, may seem in mad people, to resemble the steams arising out of the nitro-sulphureous Particles of Mineral Liquors, as they are of a fierce restless Nature, passing every way through the Interstices of the Compage of nervous Filaments, seated in the Brain, highly disordering its Oeconomy, in reference to the higher and lower operations of rational, sensitive, and locomotive Faculty too, placed at a distance from the Brain, by reason the Nerves are greatly discomposed in the muscular parts of the Body, caused by the enraged Animal Liquor and Spirits.

The Animal Spirits in a Mania may seem to resemble the motion of Mineral Waters.

The continent or immediate cause of Madness, may be conceived to come not so much from adust Choler (consisting much of sulphureous Particles, afflicting the Brain as in Melancholy) but from saline Particles, rendred fluide, and combining with ill tempered oily Particles of the Blood, resembling a kind of Arsenick Sulphure, depraving the nervous Liquor, and enraging the Animal Spirits.

The cause of Madness.

But a scruple may be made how these acide Humors (mixed with malignant Sulphure) can be generated in the Body, to which it may be replied, that highly acrimonious Recrements may be in confederacy with the Blood

in

Acide Hu-
mors may be
discharged by
Vomiting.

Acide Recre-
ments of the
Blood, vitiate
the *Succus*
nervosus.

A depraved
nervous Li-
quor may be
the cause of
many diseases.

The rise of
Madness.

Evident causes
of Madness.

Violent passi-
ons may be the
cause of Mad-
ness.

in Cacheotick Habits, as I have often seen in persons committed to my care, a a Physician, particularly in a person of Honour, who frequently vomited a quantity of acide Humors, and in a Doctor of Physick, who was perpetually afflicted with violent pains of his Limbs, proceeding from acide saline Particles of the Blood, which appeared in a great proportion of sower salival Liquor, flowing out of the Oral Glands, which vitiated the masticated Aliment, and spoiled the Chyle of the Stomach; these ill conditioned Recrements do often infect the nervous Liquor, and produce Apostemes, foul and malignant Ulcers, which are found in the parotide, axillary, and inguinal Glands; and by reason the putrid Humors of these ulcered parts, are thin and watry, it is manifest they take much of their rise from the acide Recrements of the Blood, vitiating the *Succus nervosus* (having recourse to the said Glands, the Colatories of it) which often degenerates in Scorbutick Constitutions, into a fetide corrosive Humor, which sometime proveth cancerous: And the reason seemeth plain; because the nervous Liquor is impregnated with numerous Particles of volatil Salt, which being depraved, hath its more refined Atomes depressed, as confederated with the more fixed, saline, and ferous parts of the Blood, vitiating the genuine temper of the nervous Liquor (in its first production) whose volatil parts being gone, as becoming fixed, do easily degenerate into a Fluor, and being accompanied with sulphureous Atomes, do make a corrosive Liquor (not much unlike Mineral Water) which being of a Septick nature, doth generate foul, strumous, and cancerous Ulcers in the Emunctories of the Body, and in the Glands of the Tongue, Palate, and Breasts of Women, and other parts.

This depraved nervous Liquor (productive of Apostemes, Ulcers, and Cancers in the Glandulous and nervous parts) may be reasonably apprehended to vitiate the purity of the Animal Spirits, residing in the nervous Liquor, as their subject and vehicle, which being endued with a hot sulphureous, and acide corrosive nature, may be conceived to destroy the finer parts of the Animal Spirits (the Ministers of the Faculties of Reason and Sense) and beget a Maniack disposition of the Brain, perverting the Oeconomy of the Brain, in reference to its different operations, attended with raging passions, screeches, and out-cries, and unseemly gestures, and motions of the Limbs.

This Disease taketh its rise, either immediately from the Animal Liquor and Spirits, the chief instruments of the Soul, in producing its nobler, and meaner acts of Reason and Sense; or more remotely from the Blood, as the *Materia substrata* of the *Succus nervosus*.

A Madness (arising out of the Animal Spirits) either proceedeth from an evident cause, as some extravagant passion, or from an ill affection of the Brain, caused by a Phrensy or Melancholy; whereupon a Madness often succeedeth.

A violent passion doth highly influence the Brain, and enrage the nervous Juyce and Animal Spirits (as its more refined and spirituous particles) by rendring the nervous Liquor and its Spirits highly fermentative, restless, and disorderly in wandring motions, confounding the regular operations of the Brain, accompanied with a Raging, a Delirium, and other horrid Symptoms, occasioned by immoderate Anger, great Disgrace, or Shame, or high passion of Love, breach of Vows, or scruples of Conscience, which highly discomposing the peace of the Soul, do generate a Maniack distemper of the Brain; wherein the Spirituous parts of the nervous Liquor being debased, the saline parts are exalted and brought to a Fluor, and being espoused to sulphureous Particles,

Particles derived from the Blood, do weaken the Compage of the Brain, and render the Animal Spirits fierce and unquiet, making new *Meatus* and passages, by over-much expanding the Interstices of the nervous Filaments, and causing inordinate motions, do produce delirious Phantasmes, which being offered to the understanding, do form unreasonable conceptions.

Sometimes the Animal Spirits are too much exalted, by great apprehensions of our own perfections, and the too low esteems of others; or when Men unreasonably court Honours, or when they are Masters of them, are highly puffed up, to the great unquiet and disturbance of their Minds; whereupon the nervous Liquor and Animal Spirits, are put into a great agitation and ferment, and at last acted with a Maniack affection.

Pride the
cause of Mad-
ness.

Othertimes this Disease succeedeth Melancholy, and the Phrensy, which have before indisposed the Brain, and rendred it liable to Madness; in the First being very high, the *Succus nervosus*, and its most spirituous Particles degenerate into an acide disposition, which entering into fellowship with sulphureous Recrements (coming from the Blood) do produce so fierce a temper in the Animal Spirits, that they generate a *Mania*.

A Madness
succeeding
Melancholy
or Phrensy.

A Phrensy is more akin to this Disease then Melancholy, as it is accompanied with boldness and fury, so that a *Phrenitis* is easily turned into a *Mania*, as the Brain is clogged with a fiery temper arising out of nitrous and sulphureous Particles, affecting the *Succus nervosus*, and its more active Particles; which being hurried in the fibrous Compage of the Brain, do expand the Interstices of the nervous Filaments, and make new and wandring passages in them; whereupon the Animal Spirits ranting in various progresses through the territories of the Brain, make a Maniack Delirium, and confound the acts of Reason and Imagination, commonly called Madness.

The manner
how Madness
is generated.

This Disease most commonly borroweth its first rise from an ill mass of Blood, in a great part, vitiated with gross sulphureous Recrements, sometimes caused by the ill tone of the Hepatick Glands, not discerning the bilious from the more laudable parts of Blood, produced sometimes by its grossness, and by the straightness of the excretory Ducts of the Liver; and othertimes by the obstruction or narrowness of the *Meatus Cysticus*, and *Choledochus*, whereby the Bile cannot be discharged into the Intestines, so that it is forced to regurgitate into the Extremities of the *Vena Cava*, and is thence carried with the Blood through the Right Ventricle of the Heart, Lungs, and Left Chamber of the Heart, and afterward through the common ascendent Trunk, and Carotide Arteries, into the *Cortex* of the Brain, wherein the Albuminous parts of the Blood being infected with sulphureous and nitrous Particles, do spoil the nervous Liquor and Spirits, producing a furious, mad temper in the Brain.

Madness flow-
eth chiefly
from an ill
mass of Blood.

And the acide Particles (discomposing the *Succus nervosus*, and its more active parts in the production of Madness) may claim in some part their Origen from an ill affected *Pancreas*, whose numerous minute Glands having lost their due constitution, cannot make a separation of the Recrements of the Blood from its pure substance; or when the Origins of the excretory Vessels of the Glands, or the common Pancreatick Duct are obstructed by the grossness, or quantity of the pancreatick Juyce; whereupon it being not transmitted into the Intestines, is lodged sometimes in the Interstices of the Vessels, where it being composed of Heterogenous Particles, doth ferment, and acquire greater degrees of acidity, as being sometimes brought to a Fluor, and afterward a stay being made in the spaces of the Vessels (relating to the Glands) the pancreatick Juyce is mixed with the Blood, and carried by lesser

Madness com-
ing from an
ill-affected
Pancreas.

Veins into the greater channel of the *Cava*, and by other Veins and Arteries, into the ambient parts of the Brain, wherein the Christalline parts of the Blood (as the *Materia substrata* of nervous Liquor) being debased by acide, saline, and sulphureous Particles, doth spoil the goodness and æconomy of the Animal Spirits, by giving them a high agitation, and tumultuary motion in the fibrous frame of the Brain, causing a furious disposition, attended with great fierceness, boldness, clamor, &c.

Madness is
sometimes he-
reditary.

The Disease is hereditary in diverse Families, who enjoy a regular use of their Reason and Imagination for many years, and afterward are afflicted with the dreadful Malady of Madness, which proceedeth at such a time from the due crasis of the Blood perverted, and degenerating into a nitro-sulphureous disposition, enraging the Animal Spirits, and putting them into a high disorder, in reference to a violent and unnatural motion.

The cause of
an hereditary
Madness.

And the reason of this hereditary Madness (propagated from Parents to Children by way of Generation) taketh its rise from the seminal Principle, tainted with a Maniack affection, which oftentimes exerteth it self after many years; when the seeds of this Disease, bear Fruit, and come to maturity, as fomented by ill Diet, violent Passion, Envy, Pride, Ambition, or by some other severe accidents, or disappointments in a troublesome course of life.

This hereditary Madness is not always continued, but hath many lucid intervals, and frequently returneth again at the change of the Moon, which is vulgarly called a Lunacy.

Madness may
come from an
ill Diet.

Sometimes Madness proceeds from an ill Diet, or from the suppression of accustomed evacuations, by the Hæmorrhoides, Nostrils, or Uterus in Women; whereupon the Blood (depressed by saline and sulphureous Particles) being transmitted to the fibrous frame of the Brain, doth enrage the Animal Liquor and Spirits, and produce a *Mania*.

This Disease
may be propa-
gated from
the Venenate
nature of
Blood.

The Blood also being infected with a Venenate disposition, as in a *Licantropia*, *Hydrophobia*, upon the biting of a Mad Dog, doth cause Madness, as the poisonous Miasmes are conveyed to the Blood, and raise a high Fermentation in it; and afterward in the nervous Liquor, and its choice Spirits, which giveth them a turbulent motion through the Interstices of the nervous Filaments, confounding the true use of Reason and Imagination.

This Disease
lieth long in a
poisoned
mass of
Blood, Before
it exerteth it
self

This Venenate affection lieth long in the Blood before it exerteth it self, as I have seen in one *Dyer* a Barber of *Willington* in *Sussex*, who being bit by a Mad-Dog, was well Three Months, and then fell sick of a violent Fever, attended with a raging Delirium, and a foaming Mouth, endeavouring to bite all that came near him, and afterward died, about the Fourteenth day of his sickness.

The manner
how the poi-
son flowing
from the bi-
ting of a Mad
Dog, is con-
veyed to the
Heart.

This venome infecting the Blood (caused by the biting of a Mad Dog) is mixed with the salival Liquor, and first carried into the Veins of the ambient parts of the Body, and then by greater and greater Channels, is communicated to the Heart and Lungs, and afterward by the ascendent Trunk of the *Aorta* and Carotide Arteries, into the Cortical Glands of the Brain, where it infected the nervous Liquor and Spirits, lodged in the fibrous parts of the Brain; whereupon the Animal Faculties lost their due Oeconomy, and a raging Delirium ensued, destructive of Reason, Sense, and Life.

Having given an account of the Essence, and continent cause of this Disease, it may not seem altogether amiss to speak somewhat of its symptoms, following it as so many attendants.

So that this Disease is not accompanied with the sneaking guards of Fear and Sorrow, as in Melancholy, but with Boldness and Courage, attempting any assault, though never so desperate, which proceedeth from the enraged Vital and Animal Spirits, acted with nitro-sulphureous Particles, which render the Blood highly fermentative and spirited, and put the Animal Spirits into irregular motion; whereupon the Soul is so highly disordered, as if it would violently leap out of the confines of the Body, in which it seemeth to be imprisoned.

The symptoms of Madness. The ætiology of the symptoms of this Disease.

The active and fierce particles of the Blood put it into an extraordinary motion and great effervescence, which highly acting the carious Fibres of the Muscles, do render them vigorous and strong, able to encounter the great opposition of others, that endeavour to master Mad men, and bring them to obedience, when they are guilty of extravagant actions, offering violent hands to themselves and others, and give great disturbance to the Families where they live and converse.

It is also very remarkable, that Mad Men endure Labour and Travail, and great conflicts, without any manifest weariness, which is occasioned (as I humbly conceive) from the nature of Vital and Animal Spirits, which though they are impregnated with many volatil Particles, yet they are also debased too with nitro-saline fixed Atomes, which do confine the more subtle and spirituous parts of the Vital and Animal Liquor, not suffering them to evaporate and quit those noble Juices; whereupon Mad Men, when exposed to long and laborious action, which is frequent with them, are not easily tired, but will fight and struggle in high fury, to the wonder of the beholders.

Mad Men are highly patient of Labour.

This Disease often followeth Melancholy, and is produced by a great ebullition of Blood (rending the *Cortex* of the Brain very dry) whence ariseth a great fierceness of the Vital Spirits, causing high boldness and fury:

The cause of rage in Madness from bilious Particles of Blood. An Instance of this case.

A Citizen being first addicted to Melancholy, afterward fell into a violent Distraction and Madness, attended with Rage, which could not be appeased by the power of Art, and proper Medicines.

And after death the Skull being taken off, the *Cortex* of the Brain appeared very dry, and of friable nature an Inch deep, where it was hued with Yellow, as tinged with bilious or sulphureous Particles of the Blood.

In this Malady the Brain is often tumefied, taking its rise from a great quantity of Black, torrefied blood, sometimes extravasated, and other times lodged in the Vessels, making them varicose, and knotty.

The Brain is often swelled in Madness.

A Child complaining first of a great pain of his Head, afterward fell into a high distraction (howling like a Dog) and so continued till he died. And his Skull being removed, the Brain was very much swelled, and the *Dura* and *Pia mater* had their Vessels very turgid with Black Blood, which was also very much lodged in the *Sinus*, and torcular of the Brain; and in the more inward parts of it, were discovered a great many Red specks, coming from Particles of extravasated Blood, and afterward the lower Region of the Brain being opened, a quantity of serous Recrements gushed out.

An example of a tumefied Brain in a Mania.

Other times Madness issueth from putrefaction of the Coats and substance of the Brain, (out of which arise sharp and fierce Humors, infesting the Animal Liquor and Spirits) which hath been observed in Dissections.

Madness coming from the putrefaction of the Coats and substance of the Brain. The difference of Madness.

This Disease admitteth many discriminations, as being sometimes of a small continuance; other times lasting and habitual; sometimes continued, and other times hath lucid intervals, and is very various in reference to its several symptoms, and distractions:

As

As to the Prognosticks of this Disease, it is seldom mortal, but very difficult to be cured, by reason the Blood, and nervous Liquor are highly disordered with nitro-sulphureous Particles, which are hardly removed, and the Patients affected with this Malady, can scarcely be perswaded to take Medicines, as being Enemies to themselves, as well as Physicians.

The Indications.
First, is the Curative.

The Cure of Madness importeth as great a difficulty as advantage (oftentimes successive to Melancholy and Phrensy) in which Three, the primary Indications do offer themselves; The First is Curative, relating to the Disease, and consisteth in the reducing the exorbitancies of the Animal Spirits, to a due and regular motion.

The Second is Preservatory.

The Second Indication is preservatory, and is referred to the causes of the Disease, to correct the nitro-sulphureous Particles of the Blood, enraging the Animal Liquor and Spirits.

The Third is Vital.

The Third Indication is Vital, as it supporteth Strength and Life, and denoteth restorative and corroborating Medicines, and wholesome Diet, easy of digestion, as not being of too high a nourishment, which ever feedeth the Disease, rather than the Patient.

The means advised in the Curatory Indication.

The Curatory Indication, is much assisted by the prudent conduct of Friends and Servants, giving good Council sometimes, and othertimes threats, blows, and bonds, which often awe the servile refractory temper of Mad Men, who else will not be governed in the taking of Aliment and Medicines, and will not submit themselves, unless they be over-powred by force, to which they are as passive as Brutes, with whom they hold some Analogy, as destitute of Reason.

Severity is very powerful in the cure of Madness.

And nothing more reduceth this kind of Patients to a perfect understanding, and perfect enjoyment of themselves, then by the severe Treatment of their Bodies; whereupon a high restraint rendreth them humble, and submissive, whereby the arrogance and fierceness of Mad People being subdued, they return to themselves, in the regular exercise of their rational and sensitive Faculties.

Free Bleeding is very proper in Madness.

As to a course in Physick, nothing is more beneficial then free Bleeding, which giveth an allay to the fierceness of it, by taking away its quantity and height, and abateth the tumultuary motion of the Blood, and Animal Spirits, through the fibrous Compage of the Brain; to this end an aperition of Veins may be frequently celebrated (if it be consistent with strength) in the Arm, Neck, Veins of the Forehead, and above all (I conceive) the opening of the temporal Artery, may speak an advantage to the Patient in this Malady, as it letteth out some of the enraged mass of Blood, whose motion and fury is most eminent in the Artery; and by this operation, I have seen very good success in this Malady, as it evacuates some part of the hot furious Blood, that the rest may be the more easily contempered by the application of cooling Medicines.

The opening of the Temporal Artery is very good in this Disease.

Vomitortes are very advantageous in Madness.

Vomitortes are very beneficial in this Disease, as it dependeth upon Blood, tainted with nitro-sulphureous Particles, often proceeding from the obstruction of the Liver, *Pancreas*, and other *Viscera*, which are opened, in reference to their excretory Ducts, by the violent motion of the Stomach, drawing the Guts into consent; whereupon they violently contracting themselves upward in an inverted peristaltick motion, do throw up Bile and acide Recrements out of the Intestines into the Stomach, whereby the Blood being depurated, giveth less annoyance to the Head.

Take

Take of an infusion of *Crocus*, or Sulphure of Antimony, prepared with some grains of Tartar, or some grains of White Hellebore, or *Mercurius vitæ*, given in some proper vehicle. Mercurial Medicines, (given with Purgatives, or without) as of *Calamelanos* of it self, or quickned with some few grains of Turpeth Minerale, move a salivation, and often discharge an habitual Madness, by reason sometimes a great evacuation of salival Liquor coming of it self without the help of Art, doth cure a Maniack disposition.

Mercurial Medicines often prove successful in Madness.

Strong Purgatives do also speak a great advantage in order to the cure of this stubborn Malady, as they depresse the height of the fierce Humors, and lessen the quantity of the saline, serous, and sulphureous parts of the Blood, and nervous Liquor (conjunct causes of this Disease) as the infusion of Black Hellebore in White-wine and Water, prepared with Tartar, and Seeds of Caraway, or Coriander, as the *Decoctum Sen. Gereonis*, prepared with *Epithymum*, *Mechoacan*, *Turpeth*, &c.

Strong Purgatives are good in this Disease.

As also a Bolus of Extract of Helebore, with *Calamelanos*, &c. As also *Pilula Coch. Min. Fatid. Major*, hightened with some grains of the Trochichs of *Albandal*, or Resin of *Scammony*, or Jalap.

The preservatory Indication, hath relation to the cause of this Disease, and doth much take off the nitrous and sulphureous parts of the Blood, and correct the Acrimony of the nervous Liquor, and irregular motion of the Animal Spirits.

The preservatory Indication consisteth much in sweetning the mass of Blood.

A Mineral of Cristal, or Nitre well prepared; as also Spirit of Sulphure, or Vitriol, incrassating the thin and hot mass of Blood, and attemperating the raging quality, are very beneficial in appeasing the violent motion of the Blood, and the nervous Liquor and Spirits.

The Blood may be allayed by Minerals.

Chalybeat Syrupes, Tinctures, Electuaries, mixed with cooling Medicines, do speak a great allay to the furious Blood, and extravagant motion of the Animal Liquor, and its more refined Particles, by drinking now and then a draught of Diet-drink, made with *Sarza* or *China*, in which the Flowers of Water-Lilies, Cowslips, or Lily of the Valley may be boiled, and it being strained, may be sweetned with Syrupe of Water-Lilies, or Lime-Flowers, or Lily of the Valley.

Chalybeats are very proper in a Maniack disposition. Diet-drink.

Whey Clarified, prepared with the Flowers of Water-Lilies, Betony, Cowslips, &c. may be given for an ordinary drink in this case; As also Emulsions prepared with the cooling Seeds, White Poppy, blanched Almonds, &c. may be of great use.

Clarified Whey, prepared with Water-Lilies.

Decoctions of the tops of Borage, Bugloss, fragrant Apples, the shavings of Ivory, the Flowers of Borage, Violets, Cowslips, Water-Lilies, &c. are very profitable; As also Apozemes of Pimpernel, (having a Blew Flower) St. Johns-wort, &c.

Decoctions of Borage, &c.

Electuaries also prepared with Conserves of Flowers of Water-Lilies, Lily of the Valley, Cowslips, cooling Seeds powdered, as Powder of Haley, &c. made up with Syrupe of Water-Lilies, drinking immediately after it, a draught of cooling, or specifick Apozeme.

Electuaries.

The vital Indication hath a regard to the preservation of Strength, as the said Electuary; As also an Electuary made with Sage Flowers, Rosemary, Pæony, Cowslips, Water-Lilies, which contemperate the hot disposition of the Brain, and corroborate it.

Cordials.

After which, a draught may be taken immediately prepared with Flowers of Betony, Rosemary, Sage, or Tey, and the like, sweetned with Syrupe of Cowslips, or Water-Lilies.

In point of Diet, all strong and full nourishment is to be avoided, as keeping the Blood high and enraged, wherefore it is more reasonable, to advise a thin Diet of Water-gruel, Barley-Cream, thin broth of a Chicken, Mutton, Veal, &c.

Hypnoticks
may be pro-
per in this
Disease.

And by reason Sleep is very requisite to compose the unquiet Animal Spirits, gentle Hypnoticks may be advised, of Cowslips, or Red Poppy-water, or that of Lime-Flowers, or Lily of the Valley, with some Cinnamon-water (distilled with Barley) and Syrupe of Poppy.

Cupping-glas-
ses proper,
presently af-
ter the biting of a
Mad Dog.

In reference to Madness (proceeding from the biting of a Mad Dog, Wolfe, Viper, &c.) Cupping-glasses, with Scarifications, may be immediately applied to the wounded part, or Pidgeons, or any other Bird, opened in the middle, and administered to the part affected, do draw out the venenate Humor (mixed with the salival Liquor) entering into the Extremities of the Veins, seated near the surface of the Body; Or Leeches may be applied to the wound, to suck out the infected Blood.

Leeches may
be applied to
the wound.

Attractive
Medicines
may be well
applied to the
wounded
part.
Cauterizing a
potent means
to draw poi-
son out of the
wounded
part.
Potential
Cauteries are
very advan-
tageous in this
Disease.

A Vein can-
not be pro-
perly opened
in this kind of
Madness.

And afterward attractive Medicines may be used, made of Garlick, Pidgeons dung, Mustard-seed, mixed with Walnut Leaves, Salt, and Honey: As also Plaisters made of Pitch, Opoponax, &c.

And the most ready way to draw out poison in this case, is to apply an actual Caution, and the burning being past, care is to be taken, that the crust be speedily taken off, to discharge the venom by an Ulcer, and if the Patient be so timorous as not to admit an actual Caution, a potential may be used, as Escharoticks and the like, made of sublimated Mercury, and Precipitate, and the Ulcer may be long kept open, lest some parts of the venom be retained in the Body.

In this case a Vein cannot safely be opened, which weakeneth the Body, and not dischargeth the poison. And Purgatives cannot be advised, as drawing the poison from the circumference to the Center, from the ambient parts to the Heart.

Thought of Diet-drugs made with Sassa or Clove, in which the Vein may be boiled, and it be-
of Water-Lilies, Cowslips, or Lily of the Valley may be boiled, and it be-
may be sweetened with Syrupe of Water-Lilies, or Lime-Flow-
ers, or Lily of the Valley.

Whicy Clarified, prepared with the Flowers of Water-Lilies, Betony,
Cowslips, or any other given for this case. As also
Fumitory prepared with the cooling seeds, White Poppy, blanch'd Al-
monds, &c. may be of great use.

Decoctions of the tops of Borage, Bugloss, fragrant Apples, the thavings
of Ivory, the Flowers of Borage, Violets, Cowslips, Water-Lilies, &c. are
very profitable. As also Apocynus of Pimpernel (having a blew flower)

St. Johns-wort, &c.

CHAP. P. A. H. C. also prepared with Concoctives of Flowers of Water-Lilies, Lily
of the Valley, Cowslips, cooling seeds powdered, as Powder of Halsey, &c.
made up with Syrupe of Water-Lilies, drinking immediately after it a draught
of cooling, or spedic Apocynus.

The viul Indication hath a regard to the preservation of strength, as the
said Electuary: As also an Electuary made with Sage Flowers, Rosemary,
Pony, Cowslips, Water-Lilies, which counteract the hot disposition of
the Brain, and corroborate it.

After which a draught may be taken immediately prepared with flow-
ers of Betony, Rosemary, Sage, or Tey, and the like, sweetened with Sy-
rupe of Cowslips, or Water-Lilies.

C H A P. LXIX.

Of Stupidity and Mopishness.

THIS dull disaffection of Stupidity or Mopishness, is often a sad consequent of an habitual Madness, sometimes degenerating into it, and speaketh a defect in the intellectual Faculty, as not exerting its operation, produced by the faults of the Imagination and Memory, not duely presenting their Objects to the nobler Faculty of the Understanding (the subject of our present discourse) proceeding from the disaffection of the nervous Liquor, and Animal Spirits.

Stupidity is sometimes a consequent of habitual Madness. The description of this Disease by its symptome.

The sensitive Soul is ministerial to the rational, and hath the imagination, as its principal representative of the images of things: first imparted by the outward Organs of Sense, and afterward to the Phancy, sometimes apprehending Objects, which being first lodged in the Memory as a repository, are afterward offered to the imagination, whose notions are speculated by the understanding, viewing and considering them, in order to exert its more excellent operations; whereupon, if the acts of the Memory and Phancy be impeded by some defect of the Brain, in point of an ill *Succus Nervosus*, and its more refined Particles, the light of the Understanding receiveth an Eclipse, as it is veiled by the clouds of the Memory and Imagination, unduely offering phantasmes to the higher power of the Intellect; So that our present Province being to give an account of the Pathalogy of Mopishness, doth induce me to discourse of the causes; whereby the operations of the Memory and Phancy are rendred defective, in order to the more sublime Arts of the Understanding.

The sensitive
Soul is subser-
vient to the
rational.

The seat of the inward corporeal Functions of the sensitive Soul, being seated in the *Corpus callosum*, and the more inward Recesses of the Brain, are exerted by the nervous Liquor, and Animal Spirits (the Ministers of the Soul) which being hindered in their due temper and motion, do discompose the Memory, Phancy, and Understanding, and produce a stupidity or Morbidity, sometimes derived from a Maniack disposition, destructive of the tone of the fine Spirits of the Brain.

The seat of
the inward
sensitive Fun-
ctions of the
Soul.

In stupidity, the Animal Spirits are bereaved of their fine Ingeny, as rendered destitute of their active Particles; so that their fine volatil Atomes grow fixed and depressed, as also mixed with watry Recrements in the Brain.

One cause of
Mopishness, as
the Animal
Spirits are
rendred un-
active.

This Morbidity sometimes happens only by the defect of the more spirituous Particles of the *Succus Nervosus*, and other times is caused by the fault of the Brain, as the subject and Organ of the Animal Faculty is constituted of many requisite conditions, enabling it to perform its operations; so that if any of them be deficient, or depraved, the acts of the understanding are more or less clouded, according to the greater or less indisposition of corporeal Organs.

This Disease
is also caused
by the defect
of the Brain.

And it hath been commonly observed, that the Ingeny of Man is sometimes lessened, or abolished by the too great or little dimensions of the Brain, and othertimes by the ill Figure, or Texture of it.

The narrow
intervals of
the nervous
filaments,
productive of

The too great quantity of Brain, may hinder the operations of Understanding.

A want of Understanding may proceed from an over-much largeness of the Brain, as being sometimes furnished with few Animal Spirits, or an ill fibrous Compage, not duely constituted; or a defect of Reason may come from a small proportion of Brain, in which a paucity of nervous Liquor, and Spirits are generated.

A Stupidity may proceed from an ill Conformation of the Brain.

A Stupidity also may arise from an ill Conformation, or Figure of the Brain (which ought to be of a Spherical shape, and when it is either too much depressed or prominent, it indisposeth the true situation of the nervous Fibrils, (chiefly constituting the frame of the Brain) whereupon the nervous Liquor, and its more agile Particles, have not a free and regular motion in order to the exercise of the meaner and more excellent operations of the Brain: So that the fibrous Compage, the Brain being distorted, the Fancy like a false Looking-glass maketh an ill representation of Phantasmes to the Understanding, discomposing the due and proper notions of things.

The Texture of the Brain may be disordered by the excess of First qualities.

The laudable Texture of the Brain may be much disordered by the excess, or defect of heat, as over-powred by cold watry Recrements, rendring the nervous Compage of the Brain weak and flabby, and utterly unable to accomplish their due tension, in order to promote the progress of the *Succus Nervosus*, and its more volatil parts, which being too thin and agile, do transpire and evaporate, as being not confined within their proper sphere, by the more solid parts of the nervous Liquor.

The gross and earthy Compage of the Brain, may be the cause of Mopishness; as also overclouded by steams.

And not only the Brain is disaffected by excess of coldness and moisture, as in old persons and Children, rendring them very dull and stupid in their conceptions; but the Brain is rendred highly incapable of accomplishing its acts, as its fibrous Compage is gross and earthy, and the Texture of it is ill framed, as being over-clouded by gross Fumes or Vapors, or as being too dense and compact, making it too opaque; so that the lucid Particles of the Animal Spirits not able to diffuse themselves through the gross substance of the Brain, do leave it unapt for the performance of its Functions: whereupon this Disease is sometimes hereditary, as propagated from Parents to their Children, by gross seminal principles, which are affected with the ill frame of the Brain, and its gross nervous Liquor and Spirits, which are ingredients in the genital Liquor, producing an ill Compage and Substance in the Brain of Children.

Fenny Air may concur to the production of this Disease.

In some, the dull, gross, fenny Air hath a great influence on the Blood and nervous Liquor of the Inhabitants, so that Men were styled Fools in *Boeotia*, as breathing in a thick Air, wonderfully discomposing their Wit, and rational Faculties, rendring them senseless and stupid.

An ill Conformation of the Brain may generate Mopishness.

Beside these preternatural indispositions of the Brain, another doth disaffect it, which is an ill Conformation, as the Interstices of the Filaments, are so narrow and small, that the nervous Liquor and Spirits want a free passage through the fibrous Compage of the Brain; whereupon their Animal operations are not duely celebrated; and these spaces of the Filaments are not only too close, but sometimes over lax, as being clogged with serous Recrements, spoiling the nervous frame of the Brain of its due tenseness, much hindring the progress of the *Succus Nervosus*, and its more noble Particles, the immediate instruments of the sensitive, and intellectual Powers.

The narrow Interstices of the nervous Filaments, productive of this Disease.

Sometimes the close Interstices of the nervous Filaments, do associate with gross unactive Animal Spirits, which so dull the Brain, that it cannot exert its operations; whereupon the *Succus Nervosus*, and its crass Particles cannot act the nervous Compage of the Brain, as losing their free motion in the over-straight spaces of the nervous threads, which do cause a want or dulness of Wit and Judgment.

There

There are many evident causes productive of this Disease, as an ill mass of Blood, and nervous Liquor, proceeding from an ill Air, gross Diet, deep Thoughts and Passions of the Mind, which render the Animal Spirits unactive, causing oftentimes a stupid indisposition, and defect of Sense and Reason.

The evident causes of Mopishness.

Sometimes the generous Particles of the Blood and nervous Liquor, do evaporate, and grow effete and vapid (as generous Wine having lost its oily and volatil Particles turneth faint and paled) whereupon young Men growing old, lose the perfection of the vital and nervous Liquor, and the Animal Spirits acquire a dull sluggish disposition, not fit for motion.

The vital and nervous Liquor sometime grow Effete in this Disease.

The Blood and Animal Liquor is often enervated by Luxury, Venery, and ill Diet; whereupon the Body is rendred sick and decayed, and the Compage of the Brain loseth its tenseness, as growing flaccide in Hypochondriack Bodies; and the nervous substance of the Brain suffereth a great weakness and resolution in frequent Convulsive motions, in Apoplexies, Hysterick Fits, Epilepsies and the like; so that I have seen some become Mopes and Stupid, after many fits of Cephalick Diseases.

Luxury destroyeth the purity of the Animal Liquor.

Convulsive motions often produce Mopishness.

Early Wit in Children often degenerates into dulness (according to the vulgar proverb, soon Ripe, soon Rotten,) by reason the finer parts of the *Succus Nervosus*, being over-active and thin, do often quit their subject, and leave it gross, and spiritless, making the Brain unfit to perform its operations.

Early Wits degenerate into Dulness.

Great strokes upon the Head, making concussions of the Brain, do hinder the due and regular motion of the Animal Spirits in the spaces, placed between the nervous Filaments, and make Men dull and sottish, and sometimes Mad.

Great strokes upon the Head hinder the motion of the Animal Spirits.

When Men frequently indulge themselves in the immoderate use of Wine, Ale, Brandy, and Strong-waters, their Stomach loseth its concoctive Faculty, making an ill Chyle, and mass of Blood, consisting of Heterogeneous fermentative Elements, which destroy the purity of the vital and nervous Liquor, rendring the Animal Spirits unable to perform the functions of the Mind.

The frequent and too great Doses of Opiats do incrassate the mass of Blood, and nervous Liquor, and are endued with a malignant Temper, very offensive to the Animal Spirits, by rendring them Effete and Vapid, and unfit for motion; so that the Brain loseth its Tone, and cannot well accomplish the acts of Sense and Reason, often making Men Mopes and Sots.

Opiates too frequently administered do beget Mopishness.

Violent passions of the Mind (as a pannick Fear, and deep Sorrow, and the like) do strike so great a terror, that they unman the Patient, and confound the regular motion of the *Succus Nervosus* and Animal Spirits, rendring a Man stupid and senseless, and not able to make provision for the preservation of his Life and Person, as being betrayed by passion in time of Battle; So that as the Wise man saith, Fear betrayeth those succors that Reason offereth.

Violent passions do produce this Disease.

Melancholick, and Hypochondriack Persons sometimes acquire a Morosis, which happens to persons of deep Thoughts, often addicted to the Study of Learning; whereupon, the Animal Spirits are depauperated, and the acts of Sense and Reason diminished, or wholly abolished in Fops; So that Thoughtful and Studious persons often propagate Fools, as they

Deep Thoughts sometimes cause Mopishness.

over-much indulge deep Meditations, which do much employ the *Succus Nervosus*, and its more noble Particles in the Brain, hindring their progress down toward the Testicular Glands; wherein the Seminal Liquor wanting a due proportion of nervous Liquor and Animal Spirits (as their excellent Element) cannot produce a well-disposed Brain; whence ensueth a defect of right Reason and Sense,

The distinction of Mopishness. The First hath a defect of Memory, &c.

These Diseases of Stupidity and Mopishness, if strictly inquired into, may admit a distinction, as the First hath a defect of Memory, Imagination, and Judgement, so that the persons affected with stupidity, are not well apprehensive of notions, nor judicious in the right consideration of things, and treat others with ridiculous Language, and Gestures; but that Mopish persons have somewhat more of the use of Reason, is manifest, as understanding simple notions, and retaining them sometime in their Memory, but by reason of a defect in Judgment, cannot compound and divide the notices of things; and entertain their companions sometimes with frivolous impertinent discourses; and other times with dull Silence, and refractory Humors.

A defect of Judgment sometimes a cause of Mopishness.

Mopishness may be derived from other Diseases

Our aim at this time is to give an account of both of them, as they proceed from diverse Causes, some being accidental, as Mopishness flowing from other diseases of Madness, Hypochondriacal distempers, Hysterick, Epileptick, and Apoplectick Fits, &c. Whereupon the *Succus Nervosus* is often thickened and effete, as having lost its more volatil saline Particles; whereupon the Animal Spirits are rendred few and pawled, as having lost their more fine Particles, whereby they become disabled to exert the Animal Faculties.

Mopishness may proceed from a natural defect of Sense and Reason.

And I humbly conceive, that *Stultitia*, or Stupidity ariseth out of a natural defect of Sense and Reason, proceeding from the ill Figure, and Conformation of the Brain; and when the *Succus Nervosus*, and its more select Particles are naturally indisposed, as being hereditary, imparted from vitiated seminal Liquor of Parents, which is much more difficult to be cured, then the acquiste diaffection of Mopishness, which in time by due methods of Physick, may be cured in some degree.

A hereditary Mopishness.

The Prognosticks of Mopishness.

As to the Prognosticks of Stupidity, if it be in a high degree wholly, or for the most part cancelling the acts of right Reason and Imagination, especially if it be Connate and Hereditary, doth shew it incurable; yet Children that are somewhat stupid, and dull in the acts of Wit and Judgment, in riper years get their parts more elevated, and obtain a better use of Reason and Sense, as having the temper of the *Succus Nervosus* and Animal Sprits, endred more refined and volatil.

If this Disease be accidental and acquiste, as proceeding from some gentle Cephalick Diseases, it may be cured, and the Animal Faculties return to their regular operations: But if Stupidity, or rather Mopishness be derived from an inveterate Epilepsy, or a Lethargy, *Coma*, *Carus*, or Apoplexy, the Malady proveth incurable, as having the Crasis of the nervous Liquor, and Animal Spirits, wholly perverted.

If a Lethargy be not of any long continuance; as also a *Comatose* indisposition, it may admit a Cure, and the Animal Powers, and their acts may be reduced in some degree, if not fully, to their Original temper, as having the Brain and its peculiar Juyce and Spirits repaired by a proper course of Physick, which I have seen in many of my Patients.

Sometimes

Sometimes this Disease, if it be not too deeply radicated, having not long perverted the Oeconomy, a supervening Fever in some sort may produce a Cure, as refining the Blood, and nervous Liquor and Spirits, by Fermentation; whereupon their impure Recrements are thrown off by Urine, and a free transpiration through the excretory Ducts of the Skin; so that the Vital and Animal Liquor being depurated, the Spirits recover much of their former Crasis.

As to the Cure of this Disease, if it do not arrive to a great degree of Stupidity, but rather an extraordinary dulness in the exercise of the acts of Reason and Sense, it may in some sort admit a recovery, by the assistance of a good Tutor (as well as a Physician) which may contribute much by good Rules and Precepts of Art, to the advancement of heavy parts, affected with a mean apprehension, and Judgment.

This Disease in some cases, may admit a Cure.

The advice of a Physician may be proficuous, as giving good prescriptions of proper Medicines, to depurate the Vital and Animal Liquor and Spirits, by rendring them active and volatil, and by dispelling the dark Clouds and Vapours of the Brain, to make way for the reception of lucid Particles, perfective of the Animal Spirits, the immediate instruments of the Animal Powers.

In plethorick Bodies, labouring of Stupidity and Mopishness, a Vein may be opened in the Neck, Forehead, Arm; as also Leeches may be applied to the Hæmorrhoidal Veins.

Bleeding may be used with good success in this Disease.

Fontanels may be made in the Arm, Neck, between the Shoulders, or in the inside of the Thigh or Leg, to divert gross Recrements from the Brain, and relieve the Blood and nervous Liquor, and its more spirituous Particles; whereupon they become more fit instruments to celebrate the operations of the Brain.

Fontanels proper in Mopishness.

Purging Medicines, prepared with Cephalicks, may be very proper in these Diseases, to refine the Blood, and *Succus Nervosus*; so that the Animal Spirits may be exalted, and the Crasis of the Brain rendred laudable duely to exert the acts of Imagination, Memory, and Reason.

Purging Medicines prepared with Cephalicks.

Apozemes are very advantageous, made of Lime-Flowers, Lily of the Valley, Betony, Sage, Rorismary, to which may be added Compound Pæony-water, Syrupe of Pæony, Lime-Flowers, or Lily of the Valley.

Cephalick Apozemes.

Spirit of Hartshorn, and Salt of Ammoniack succinated, may be given in a draught of Black-Cherry Water, Lime Water, or Lily of the Valley, Pæony and the like, Morning and Evening.

Spirits

A Magistral distilled Water may be good, prepared with the Flowers of Betony, Sage, Majoram; the Flowers of Rorismary, Sage, Lime, Lily of the Valley, Pæony, Nutmegs; and besprinkle them with Canary for Twelve hours, and afterward distill them in a large quantity of Milk in a Rose Still; to this distilled Water may be added a small quantity of Compound Pæony, or Compound Briony Water, or a small proportion of Spirit of Lavender.

A Magistral distilled Water.

Or in a draught of this distilled Water may be given some drops of the tincture of Castor, Amber, or *Elixir Proprietatis*, &c.

An Electuary prepared with the Conserves of the Flowers of Sage, Rorismary, Betony, Lime, Lily of the Valley, mixed with Condite Eringo Roots, or Citron-Pill, or that of Auranges, Limons, Powder of Castor, Amber, Pæony-Roots, made up with Syrupe of Lime-Flowers, or Lily of the Valley, drinking after it a good draught of the distilled Water above advised.

Cephalick Electuaries.

Ale, medica-
ted with Ce-
phalicks.

Ale, medicated with Flowers of Sage, Betony, Lime, Lily of the Valley, Rorismary, Cubebs, Nutmegs, Mace, &c. may be very beneficial in these Diseases.

Topicks may
be safely ad-
ministred.

Balsamick Ointments, and Emplaisters made of Cephalicks; as also Fomentations of the same kind may be applied to the Head shaved; as also Caps quilted with the Flowers of Lime, Lily of the Valley, Sage, Betony, Lavender, Rorismary; Spices of Mace, Nutmegs, Cloves, Galangal, &c.

Linements of Balsame of *Tolu*, natural Balsame, *Capivium*, Oil of Nutmegs, and Mace by expression, may be administred to the Head (when shaved) with good success.

CHAP.

C H A P. LXX.

Of Convulsions and Convulsive Motions.

IN the Pathology of the Brain, my intention is to Treat of a Convulsion, and how it differeth from Convulsive Motions, as the one disagreeeth from the other in several positions of the Muscles and duration of their involuntary motions: In a Convulsion the Limbs and other parts of the Body have a constant rigid posture, rendring them so stiff, that they cannot at all bend, or else without great difficulty be bowed, proceeding, as I humbly conceive, from a grosser Matter than that of Convulsive Motions, so highly aggreeving the Fibrous parts, that they can hardly discharge themselves from it; whereupon the Muscles are put upon a constant trouble of unnatural Contractions, till they can free themselves from their burden by the Extremities of the Nerves and Fibres; of which I can give a notable Instance in Mrs. Susan Floide, a Patient of mine, Dr. Bathurst and Sir Charles Scarborough being joyned with me, who was strongly oppressed with such Hysterick Fits, that produced universal Convulsions through the whole Body, lying in a *Tetanus* eleven hours, wherein the exercise of her Sense and Reason was intercepted, and the whole Trunk and Limbs of her Body were so violently Contracted, that they remained altogether inflexible, and after the lying eleven hours in one rigid posture, she began in some part to be reduced to the use of Sense and Reason, and then creeping from the Bed to the Floor on which she moved divers times backward and forward upon her Hands and Feet, and afterwards rising from the Floor, she ran up and down the Chamber a good while, and then turned round again and again about thirty times, and so was restored to the exercise of all the functions of her Mind and Body for an hour, in which she supplied Nature with Aliment, and then returned again to lying on the Bed as before, and began to act over again those sad Scenes, in contracting those universal machines of Motion, and those several parts before nominated, which she did in the very same method and manner for every day three weeks or a month; so that her Friends apprehended her to be Enchanted, by reason of those wonderful symptoms which indeed were the effects of a Disease, and not of Sorcery, afterward plainly evinced in the sequel of the Cure.

The difference
of Convulsions
and Convul-
sive motions.

A most re-
markable In-
stance of great
Convulsions.

*Ut miserrimo huic ægotanti, horrenda symptomatum serie laboranti obstetice-
remus, methodo medendi ex Medicamentis fætidis variis prescribendi formul-
to instituta, sed Eben incassum omnia. Tandem venis tribus aut quater vicibus
pertusis liberali manu sanguine detraximus, cujus pars serosa quæ clara esset &
Cristallina ex naturæ præscripto, sed vi morbi opaca & turbida evasit. Latice
autem tum seroso quam purpureo copiosius emissis, generosa hæc puella bonis avibus
in pristinum salutis statum restituitur.*

Convulsive motions are nearly related to Convulsions.

The difference of Convulsive motions and Convulsions in reference to their various causes.

Convulsive motions derived essentially from the Brain.

Convulsive motions proceed from the habitual weakness of the Brain. This Disease may be derived from an acquired debility of the Brain. Convulsive motions coming from the venenate nature of the Blood.

Having in some manner treated you with the Pathology of the Brain in point of Convulsions, it may not be altogether impertinent to give you some account of Convulsive Motions, which are so near akin to Convulsions, that they are promiscuously used for each other by Learned Authors. But in a strict Sense, I humbly conceive they differ both in their Causes and Symptoms; The Convulsions flowing from a more thick Matter, are not easily shaken off, which forcibly detain the Muscular parts in one contracted stiff posture, whereas Convulsive Motions do proceed, as I conceive, from some subtle Vaporous Matter quickly insinuated all along the Filaments, and speedily discussed through the Extremities of the Nerves and Tendinous Fibres, by many violent contractions of the Muscles, which have thereupon frequent intervals of rest, by the discharge of the Matter, till new accessions are made by the Morbifick Matter infecting the Animal Liquor, impelled into the Nerves and Fibres, which giveth them a fresh trouble, causing many brisk concussions of the Muscles, which by divers great compressions empty the Tendinous Fibres of Spirituous Saline Particles, and the Carnous of Nitrosulphureous, till they receive new supplies of Nervous and Purple Liquor from the Brain and Heart, by the mediation of the Nerves and Arteries.

Hence may be assigned the reason of Convulsive Motions, which sometimes are derived essentially from the Brain by an ill Diathesis of Humors imprinted in the substance of it, creating an habitual weakness, whereby it is rendered incapable to exterminate the noysome Particles of the Blood, (by the Jugular Veins) which are received and lodged with the Animal Liquor in Pores of the Brain, which is sometimes so highly provoked by the trouble of the Matter it self; and sometimes *vehementibus animi pathematis*, wherein the Brain being highly molested, endeavoureth to free it self by forcing the Heterogenous Particles embodied with the Animal Liquor into the Nervous and Tendinous Fibres, producing great vibrations of the Muscles.

And Convulsive Motions are not only generated primarily and essentially from the Brain, by reason of an habitual weakness and ill disposition, which is sometimes hereditary, infecting the Seminal Matter, the first principle of the Brain propagated from Parents, but also from an acquired debility of the Brain, communicated to it, *vi imbecillitatis cerebri recipientis aut vitio sanguinis mandantis*, when its impure Particles are not discharged by the Lymphæducts, as some are of an opinion, or in the return of the Blood by the Veins or excretory Vessels, by Sweat and insensible transpiration; whereupon the Morbifick Matter is impelled into the Brain by the internal Carotide Arteries, whence the whole mass of Blood is infected with a venenate nature, as in Malignant Fevers, and Scorbutick and Cacochymick habits of Bodies, as also in Virulent Abscesses and Ulcers of the *Viscera*, whence arise great Ebullitions of the Blood, whose venenate impure Miasms are carried out of the Ulcered Spleen by the Splenick Branches, into the *Porta* and *Cava*, and out of the Abscesses of the Liver immediately into the *Cava*, and hence by the right Ventricle of the Heart, into the Pulmonary Artery and Vein, into the left Ventricle and the *Aorta*, but in the Abscesses of the Lungs it hath a shorter cut when the Ulcerous Matter is immediately conveyed by the Pulmonary Veins into the left Ventricle, and thence by the ascendent Trunk of the *Aorta*, and internal Corides into the Brain, whence these impurities, when they cannot be otherways discharged, are hurried with the Animal Liquor into the Nerves and Fibres, causing impetuous motions of the Muscles, which are most signally conspicuous in the Diseases of Epilepsies,

Malig-

Malignant Fevers, and Hysterick passions; as to Epilepsies, their symptoms are as stupendous as their causes and nature intricate; whence arise great Controversies both of parts affected, and the manner how the Disease is imparted to them; many do assign its chief seat to the Brain, Ventricles, and Coats of it; others to the middle and lower Venter, of which I will give you account hereafter, in the Parts affected, and the Causes and Symptoms of the Disease, and shaddow unto you the state of the Disease, which being considered in its Paroxysm, is more universal in Extent, and severe in its Nature, whence the subtle Particles of the Animal *Latex*, commonly styled Spirits, in reference to their Volatil Spirituous nature, are the chief Guests of the Brain, and are fiercely and inordinately moved, drawing into consent their neighboring parts inhabiting both the Medullary and Nervous Appendages, and thereby as it were, conjure up stupendous storms and tempests made up of great impure Vaporous Matter darting it self into the Serous Liquor of the Brain, which is thence violently forced into its Nervous outlets, causing as it were a Hurricane, making such a violent contusion of the Nerves and Fibres, that it striketh down the Patient in the twinkling of an Eye, with admirable violence to the ground, where he labor-eth under great vibrations of the Head and Neck, grindings of the Teeth, froth about the Mouth, frequent motions of the Limbs against the ground, and now and then the *Precordia* and Hypoconders are puffed up with great and frequent strokes upon the Breast; So that the *Precordia* being Convulsed, can make but disorderly Contractions, and the Blood ready to quit its motion to the great oppression of the Heart, threatneth the putting out of the gentle flame of Life; whence the Patient not by any direction of the Will, but a meer instinct of Nature, giveth many repeated strokes upon the *Thorax*; whence arise brisk concussions of the *Precordia*, which prove as so many sollicitations to revive their drooping motions, to redeem the Blood from Stagnation, and the Heart from its load and perplexity; so that sometimes all these sad Scenes are quickly changed, and afterwards are represented more pleasant Interludes of ease and repose. And now I will omit any farther discourse of this Disease, designing to give a more full History in the next Chapter.

And in order to give you a more clear and general account of Convulsive motions (which highly aggrieve the Brain, and its rational and sensitive functions) two considerables do chiefly offer themselves, the Subject, and the Causes of this Disease: As to the first, I humbly conceive it to be the tender fibrous Compage of the Brain, which being endued with acute sense, is liable to many preternatural and irregular motions, sometimes of the Fibrils, other times of the middle and extremities of the Nerves, besetting the Brain, *Viscera*, and other parts of the Body.

In Malignant Fevers and other Diseases of the Body, the Venenate nature, as also other saline and sulphureous Particles of the Blood, do infect the Nervous Liquor in the *Cortex* of the Brain, which being entertained into the extremities, do highly disorder the origins of the Nerves, and as the Animal Liquor (tainted with heterogeneous Particles) is farther transmitted into the fibrous Compage of the Brain, and other more remote parts of the middle and lowest Apartment, it violently annoyeth the middle and body of the Nerves, as infesting their numerous Plexes; And when the irritating Humors are carried into the Muscles and remote Coasts of the Body (affecting the membranous and tendinous parts) they may be properly said to be seated in the extremities and terminations of the Nerves.

The nature of Epileptic Convulsive motions is very intricate.

The subject of Convulsive motions.

The origin of the afflicted in Convulsive motions.

The body and middle of the Nerves concerned in Convulsions.

The termination of the Nerves affected in Convulsive motions.

The

The evident
cause.

The causes of Convulsive motion, may be evident when the *Succus Nervosus* or Animal Spirits are discomposed, and the fibrous Compage of the Brain being much debilitated, is violently agitated by vehement Passions.

The Proca-
tarctick cause
of this Dis-
ease.

The Procatartick cause of Convulsive motions supposeth a disposition of Humors in the Body, which being endued with highly Fermentative Elements of the Blood do vitiate the Animal Liquor and Spirits, by rendring them too Elastick, highly expanding the Filaments of the Nervous Fibrils; whereupon they briskly contract themselves, to discharge the offensive Particles of the Nervous Juice.

The continent
cause of Con-
vulsive mo-
tions, cannot
be derived
from Inani-
tion and Re-
pletion.

The continent cause of Convulsive motions, the Antients have fetched from Inanition and Repletion, which they illustrate by an instance of Lether, or Muscal Strings, which contract themselves, when moistned with much Air, or shrunk up with much drought; this Opinion seemeth very improbable by reason the abbreviation of the Nerves, cannot produce variety of postures in the Muscles, proceeding from irritated Humors, putting the Nerves into various irregular motions; and farthermore the being macerated in a great quantity of watry Recrements (in an *Anasarca*) are rendred weak and flaccid, whereby they become unable to produce strong Convulsive motions; which are acted by the Elastick Particles of the Blood caused by nitro-sulphureous Particles depraving the Nervous Liquor, puffing up the Filaments of the Nerves; whereupon they make a great renitence or opposition by powerful contractions to squeeze out the offensive Matter, disquieting the Animal Spirits, and irritating the tender Filaments of Nerves.

The continent
cause of Con-
vulsive mo-
tions.

The Convulsive motions are more or less universal, as the *Succus Nervosus* (infected with Nitro-saline or acid Ferments) is carried out of the fibrous Compage of the Brain into a greater or less company of Nerves; so that the Tendons of more or fewer Muscles are unnaturally contracted, whence proceed great variety of horrid Symptoms (attending several parts of the Body) which may be reduced principally to Three Heads; The first may proceed from a poysonous nature; The second from Malignant Fevers not well determined; whereupon the matter of the Disease (being not duly discharged) is carried into the fibrous Compage of the Brain, and into the many pairs of Nerves, sprouting out of the Brain.

The third Head of Convulsive motions may take its rise from the *Succus Nervosus*, losing its native sweet bounty, and degenerating into a sharpe, acid, Fermentative Liquor, highly afflicting the Animal Spirits, and productive of Convulsive motions.

C H A P. LXXI.

Of the Falling-Sickness.

HAVING treated of Convulsion and Convulsive motions under a general Notice, I will now discourse of them in particular, of the Falling-Sickness, attended with a dismal rout of Convulsive agitations of the Muscular Parts, seated in the Limbs and Trunk of the Body.

This terrible Disease hath many appellatives fetched from the nature, properties, and symptoms of it: And is styled by the *Greeks*, ἐπιληψία ἀπὸ τοῦ ἐκτονωμένου, from the sudden seizure of the functions of the rational and sensitive Faculties. And ἰερον νόσημα, either because it is a great Disease, or as a miraculous Disease coming from a Divine power. And is called by *Hippocrates*, νόσημα παιδίων, by reason it is familiar to Children; and named by the *Latines*, *Caducus*, a *Cadendo*, and *Comitialis*, as persons labouring of this Disease are interdicted the *Comitia*. And hath the denomination of *Lunaticus*, by reason the Paroxysms do often invade in the New and Full of the Moon.

The Names of the Falling-sickness.

This Disease may be discovered by peculiar Diagnosticks, as the Patient is of a suddain surprized with this Malady, and loseth the use of Reason and Sense accompanied with a violent Fall, froth about the Mouth, and nashing of Teeth, frequent strokes of the Breast, and Convulsive motions of the Limbs, and sometimes an universal stiffness of the whole Body, and an inflation of the Hypochondres and Belly; and the Symptoms cease of a suddain, and the Patient is reendued with Sense and Reason.

The Diagnosticks of an Epilepsy.

An Epilepsy may admit this description, of being an Abolition of the chief functions of the Brain, as well as Sense, and voluntary Motion, which is associated with Convulsive agitations of the Muscular parts, proceeding from an inordinate motion of the Animal Spirits disaffecting the fibrous Compage of the Brain, and the various Plexes of Nerves, furnishing the Muscles of the Limbs and Trunk of the Body.

The description of the Falling-sickness.

Sometimes the Fits of an Epilepsy do make their Paroxysms at set times of the Day, Month, or Year, according to the Conjunctions of Planets, as of the Sun, Moon, or their Opposite Aspects; and other times, the Epileptick Paroxysms, observe no certain type or period, which is occasioned by variety of evident and Procatartick causes.

The Fit of an Epilepsy observe set times.

These Paroxysms also are distinguished as having various degrees, some being more gentle, discernible in more easie symptoms, when the Patient doth not suffer so great a violence by the Disease, as not being affected with a Stupor, nor thrown down by strong Convulsive motions of the Muscular parts, but speedily returneth to the exercise of his rational, sensitive, and locomotive faculties.

The degrees of the Fits of a Falling-sickness.

And in others these Fits are more strong, as accompanied with more dreadful accidents, the loss of Reason, (Sense and regular motions of the Body) as having the functions of the Brain stupid, and the parts of the Body first tortured with violent agitations, and afterwards stiff, senseless, and immovable; And to this Disease Children and young Men are most liable.

A Falling-sick-
ness differeth
in point of its
various sub-
ject.

Another difference of this Disease may be derived from the variety of its subject or part affected, from which it taketh its rise, whereupon a Falling-sickness may be styled *per isota Deav*, and primary, when it proceedeth from the Brain, originally affected; and *per opota Deav*, by consent of Parts, when the Disease beginneth in some inferior part, and is afterward imparted to the Head.

The subject
of this Dis-
ease.

And now it may be worth our inquiry, what is the subject or seat of this Disease, which some affirm to be in the Membranes encircling the Brain and every way contracting it like a Purse, and others in the substance of it. As to the first opinion, it seemeth very improbable by reason it supposeth the Coats of the Brain to be universally narrowed according to all its Cavities, whereby the substance of the Brain is compressed, which if true, would produce an Apoplexy (and not an Epilepsy) as intercepting the current of Animal Liquor and Spirits into the origen of the Nerves, seated in the *Cortex* of the Brain. Farthermore, It is difficult to conceive how the Coats of the Brain can be so narrowed as to close every way and contract its ambient parts, and make a vellication of the Origenes of the Nerves, taking their rise in the *Cortex* by reason the *Dura Menynx* is so conjoyned in divers parts to the Skull, that it cannot universally compress the Brain by its too near approximation. And again, The *Pia Mater* is fastned by divers Ligaments and continuity of Vessels to the *Dura Menynx*; So that the *Pia Mater* cannot universally vellicate the fibrous Compage of the Brain in reference to an over-close contraction, unless the *Dura Mater* (to which it is firmly affixed) first give way, which in some parts it may, where it is not fastned to the Skull, and so may admit Convulsive motions, as well as the fibrous parts of the Brain, which are great Actors in this Tragical Scene of Epileptick Fits; and as numerous Fibrils, do constitute the curious and wonderful frame of the *Cerebrum* and *Cerebellum*, they may be called the seat of this most turbulent Disease, more or less discomposing the Nervous parts of the Brain and whole Body, in a strong Epilepsy.

The Coats of
the Brain can-
not every
where
vellicate the
Origenes of
Nerves.

The Fibrous
parts of the
Brain are pri-
marily con-
cerned in
Convulsive
motions.

And furthermore, I humbly conceive, that the fibrous Compage of the Brain is first affected in the Falling-sickness, and afterward the Coats do sympathize, as being composed of many small Fibrils, which are derived from those of the Brain, or at least are near akin to them in structure and situation.

The Animal
Spirits, accor-
ding to Dr.
Willis, are the
subject of the
Falling-sick-
ness.

Learned Dr. *Willis* asserteth in *Traetatu de Morbis Convulsivis Capite 2. de Epilepsia* p. 28. that the primary seat of an Epilepsie is in the Animal Spirits rarefied, and endued with an Explosive disposition, *Ait ille. Et quidem, uti verisimillimum, arbitror paroxysmum Epilepticum a spirituum animalium Cerebri incolarum (qui nempe sunt primum & immediatum hujus morbi subjectum) subita quadam rarefactione, & explosione concitati, qua Cerebrum ipsum inflatur, adeoque insensibile redditur, simulque nervi appensi in Convulsiones aguntur, hinc enim vero contingit hujus morbi accessionem ita de repente incipere, & perfecte terminari, sine magna materiae morbificae provisione, aut reliquiis, quin nempe labes, non tam partibus solidis, quam ipsis spiritibus infertur.* Wherein this Learned Author concludeth, that this most vexatious Malady is not in the solid parts, but in the Spirits themselves, as the prime and immediate subject of an Epileptick Fit, expressed above in plain terms, to which (with deference to this Great Professor of our Art) I take the boldness to speak this return; That the Humors, and Spirits, as being contained parts, are rather Causes then Subjects of Diseases, which I humbly conceive to be seated in the

The Humors
and Spirits
are causes and
subjects of
Diseases.

containing solid, rather than in the fluid parts; whereupon the Origins of the Nerves, placed in the Cortex of the Brain, are the first and immediate subject of this Disease, as they are discomposed either by ill Heterogeneous Particles of the Blood, or vitiated Animal Liquor, and Spirits, which the Learned Author conceiveth to work in the Nerves explosively after the manner of fired Gun-Powder. *Sequitur (ait ille) spiritus animales etiam systematis nervosi incolas copula explosiva imbutas; cumq; ipsis cerebri incolis in consensum trahi, ab iisq; ad explosiones pariter inordinatas excitari, licet aliquando (tota spirituum, tum in cerebro, tum in nervoso genere confitorum serie, instar longiores pulveris pyrii tractus, ad explosiones prædisposita) spasmus exterius, & à longinquo forsan in membro quodam, aut viscere incipiens; posterius in cerebrum traducatur.* And according to the opinion of this most Renowned Physician, the highly Fermentative Elastick Particles of the ill Animal Juice and Spirits, do violently irritate and agitate the tender and most fine Compage of the Nerves, as made up of numerous Fibrils (endued with most acute Sensation) the seat of Epileptick Paroxysms.

The first and immediate subject of an Epilepsy, are the Cortical Fibrils.

Nerves are the subject of the Falling-sickness.

And before we make any farther steps into the Causes, we will give some account of the Symptoms, as so many Diagnosticks leading us into the knowledge of it.

And first of the Froth, coming out of the Mouth, conceived to be a Pathognomical sign of an Epilepsy, but in truth is an attendant of an Apoplexy, Carus, and of Hysterick, and sometimes of other Convulsive motions.

Froth about the Lips is a symptom of the Falling-sickness.

Some are of an opinion, the Froth is a Recrement descending from the Brain to the Mouth, which is somewhat improbable, by reason there are no passages (coming from the Brain into the Mouth) by which the Froth may be transmitted; whereupon I apprehend it more reasonable, that the Froth being a Liquor attenuated and puffed up, as being a system of many Vesicles of Air, clothed with a thin Liquor, transmitted from the Lungs (into the *Aspera Arteria*) by the violent agitations of the Intercoastal Muscles and Diaphragm compressing the Lungs, and ejecting this Froth first into the Wind-pipe, and afterward into the Mouth.

Froth doth not come from the Head, but Lungs.

Another more dreadful Symptom is the beating of the Breast with strong blows, which I conceive is occasioned by a great oppression of the Lungs with stagnant Blood, by reason of their undue Motion produced by the strong Convulsions of the Intercoastal Muscles, and Diaphragm, whence ariseth a great difficulty of breathing, which to alleviate (Dr. Willis saith) by a meer instinct of Nature, Epileptick Persons beat their Breast, that the *Præcordia* by Appulses might make good their motions, that the Blood might be relieved from Stagnation, and the Heart from a great oppression. *Tunc fit ut laborante, cerebro licet inscio, mero naturæ instinctu, thoracem percutiant, nimirum ut præcordia ita percussa, & velut exagitata, motus suos redintegrent, adeoq; sanguis à stagnatione, & Cor à gravi oppensione vindicentur.*

The beating of the Breast is another symptom of an Epilepsy.

Another Symptom of this Disease (which is very great) is a suddain fall upon the Ground with great force, often bruising and wounding the Trunk and Limbs, as if they are possessed with some ill Spirit, which proceedeth from the suddain and violent Convulsive motions of the Origins of the Nerves seated in the Brain, whereupon the Muscles of the Limbs are drawn into consent by their highly disaffected Nerves, productive of violent Muscular Agitations; So that the Convulsed Muscles

A suddain fall upon the Ground is a symptom of the Falling-sickness.

of the Trunk, Legs, and Thighs, are not able to keep up the Body in an erect posture.

The continent
cause of an
Epilepsy.

The continent cause of this Horrid Disease (as attended with dismal accidents) is seated in the Brain, and often produced by the heterogeneous fermentative Particles of Nitro-sulphureous Elements, disaffecting the serous parts of the Blood, the *Materia substrata* of Animal Liquor and Spirits.

The Falling-
sickness pro-
ceeds from
saline Parti-
cles of Meat
and Drink.

This Horrid Disease often proceeds from a clear serous Liquor, impregnated with saline Particles (somewhat akin to *Aqua Fortis*) imbibed with the Liquors and Meat we eat and drink, as they are infected with Mineral Elements which taint the Aliment, with which Cattel are sustained; so that the Blood and Nervous Liquor are vitiated with ill Humors, which have much of the propriety of Vitriol, as having sharp, malignant, acid, astringent and corrosive qualities, which being imparted to the Vital and Nervous Liquor, do highly discompose the tender fibrous Compage of the Brain, and Nerves arising out of it, and dispensed to all the Muscular parts of the Body; whereupon not only the Brain, but the Limbs and Trunk are tortured with violent Convulsive motions, the doleful attendants of an Epilepsy.

The Nervous
Liquor is
sometimes vi-
tiated with
sharp and cor-
rosive Humors
resembling
Vitriol.

The instance
of a Patient
dying of an
Epilepsy flow-
ing from
sharp Serous
Liquor.

A young Man being seised with a violent Epileptick Fit, (accompanied with strong Concussions of the Muscular parts, and a Froth about the Mouth) was so much overpowred with it, that it spake a period to his life. And afterward his Brain being opened, was found turgid with a quantity of clear serous Liquor, in which the nervous Fibrils did seem to swim; whereupon they being highly disaffected with the sharp and acid qualities of the ill watry Liquor, were acted with Convulsive agitations, the forerunners of Death.

An Epilepsy
proceeding
from a Caries
of the Brain.

An Epilepsy may also take its rise from a Caries of the Skull, infecting the Albuminous Liquor of the Vital Liquor (with a corrupt quality) in its passage through the lateral *Sinus*, adjoining to the Skull; whereupon the *Succus Nervosus* being vitiated, highly disordereth the fibrous Compage of the Brain, productive of Convulsive motions, the sad retinue of the Falling-sickness.

An instance of
an Epileptick
Patient dying
of a carious
Skull.

A young Man was highly tortured with a pain in his Head, and violent Epileptick Fits, which at last cut off the thread of his Life; and afterward his Skull being taken off and inspected, was found to be very much Carious in the inside, which was the cause of his Disease and death, by reason his Brain being opened, appeared free from all ill Humors, which might produce the cause of the Falling-sickness.

An Epilepsy
coming from
a putrid Hu-
mor corrupt-
ing the Ner-
vous Liquor.

Sometimes this Disease may borrow its origination from a putrid Humor, infesting the Coats of the Brain, and corrupting the nervous Liquor, which is made out of the mild parts of the Blood in the Cortical Glands, and afterward received into the Extremities of the nervous Fibrils; So that they being much disordered, do draw the Nerves into consent, and produce Convulsive motions, the sad companions of an Epilepsy.

An instance of
a Falling-
sickness.

A Learned Man being highly afflicted with pain about the *Synciput*, or top of his Head was afterward surprized with violent agitations of the Limbs, and Froth about the Lips, the concomitants of an Epilepsy, and forerunners of Death.

This

This Malady may also be generated by an abscess of the Brain, corrupting its substance, and the Animal Liquor, which being transmitted to the Fibrous Compage of the Brain, and afterward to the Nerves (branched through the parts of the Body) makes unnatural motions, the common Heralds of death.

An Epilepsy produced by an abscess of the Brain.

A Youth labouring of a Fever and Convulsive motions, which determined his days; and afterward his Brain being opened, the *Dura Meninx* was discovered to have its Vessels turgid with black, extravasated, and concremented Blood, and the neighboring parts of the Brain apostemated.

An example of an Epileptic Person dying of an Apostemated Brain.

Sometimes a Falling-sickness may arise from a *Polypus* caused by a concremented Liquor lodged in the confines of the Brain, flowing from the saline Particles of the Serous Liquor of the Blood, highly annoying the tender Nerves of the Brain: Of this case Learned *Blasius* giveth an Instance, *Observ. Med. 2. Part 6. Ait ille, in sinu Menynge duræ longitudinali subjecti muliebris publice in Theatro Amstelodamensi dissecti, materia continebatur alba, tenacissima, quæ sinum replebat, & ad omnes sinus, rivulus diffundebatur; Epilepsin laboraverat Mulier jam ab aliquo tempore, qua etiam extincta.*

A Falling-sickness coming from a *Polypus* in the Brain.

An Epilepsy may also be derived from a wound of the Brain, cutting the Blood-Vessels, whence ensueth a great effusion of Blood into the substance of the Brain, producing a Falling-sickness.

A Falling-sickness coming from a wound of the Brain.

A Student was wounded in the top of the Head, penetrating through both Tables of the Skull into the body of the Brain, whereupon afterward he was afflicted with the Falling-sickness, which proved fatal to him. And his Skull being taken off, his Brain was discerned to be black and gangreened.

An Instance of a Patient dying of a Falling-sickness upon a wound of the Brain.

A Falling-sickness may be also produced by some fleshy tumor (lodged in a Ventricle of the Brain) compressing the Fibrils of the Brain, whence ensue great agitations to make good the current of Liquor and Animal Spirits passing between the Filaments of Nerves.

An Epilepsy caused by a fleshy Tumor lodged in a Ventricle of the Brain.

Of this case Learned *Rhodius* giveth an account, *Centur. 1. Observ. LV. Ait ille, Nullo ingenio huic malo admodum gravi, quandoq; medelam reperiri miretur nemo, qui communis mali causas, ut plurimum inexpugnabiles consideraverit, quidam singulari Ich. Prævotii fama excitatus, recuperandæ valetudinis spe Pataviam venerat. Nullo effectû ad suos reversus, quum paulo post fato cessisset, in cerebri Ventriculo tumor Carnosus fuit inventus, qui cerebro compresso inanem huic Morbo Medicinam docuit; So that any compression of the Fibrils of the Brain, proceeding from a Swelling, or from concremented Blood lodged upon the Surface of Brain, may produce a Falling-sickness accompanied with Convulsive motions, whereby Nature endeavoureth to relieve her self by violent agitations of the Nerves.*

An example of the Falling-sickness.

A Child of mine being roughly treated by an imprudent Midwife, was pulled into the World, by the Head without Throwes, whereupon a great Fracture of both Tables of the Skull did arise, and a large source of Blood fell down, by the laceration of Blood-vessels, upon the *Dura Meninx*, compressing the Origins of the Nervous Fibrils (seated in the *Cortex*) so that the Brain being aggrieved by a quantity of concremented Blood, did attempt to discharge its load by Epileptick Fits, attended with Convulsive motions, the mournful prologue of Death.

An example of an Epilepsy proceeding from a Fracture of both Tables of the Skull.

A Falling-sickness may proceed, not only primarily *per idiopathiam*, from the disaffections of the Brain, but *per sympathiam* too by consent, originally flowing from the Maladies of other parts. And sometimes from a Gangreen of the Lungs, following an inflammation, whence some part of the putrefied Blood being communicated by the Carotide Artery to the *Cortex*

An Epilepsy per sympathiam coming from a Gangreen of the Lungs.

of the Brain did highly discompose the Nervous Fibrils, and put them upon violent agitations, productive of Epileptick Fits.

A young Man having drunk a great quantity of cold Water, and lying long upon the Ground, fell into a high Fever, and *Delirium*, accompanied with a great pain of his Head, and Epileptick concussions of his Body, and Limbs, which concluded in death. And afterward his *Thorax* being opened, the right Lobe of his Lungs were found black and gangreened, oppressed with a large quantity of gross concremented Blood.

A Falling-sickness coming from an Ulcer of the *Pancreas*.

A Falling-sickness may be sometimes derived from the Ulcer of the *Pancreas*, tainting the Blood, which being transmitted by proper Vessels to the Cortical Glands of the Brain, infecteth the Nervous Liquor, whereupon it being received into the Origins of the Fibrils, putteth them upon irregular motions, causing an Epilepsy.

An Instance of an Epilepsy flowing from an Ulcered *Pancreas*.

An example of this may be given in an Hysterick Woman, who laboured with violent Convulsive motions (the retinue of the Falling-sickness) ending in a fatal storm; And afterward her Body being opened, the *Viscera* were found very free from any Disease, except the *Pancreas*, which was highly Ulcered, and the cause of her Death.

An Epilepsy proceeding from the Diseases of the Stomach and Guts.

An Epilepsy may be also derived from the Diseases of the Stomach and Intestines, labouring of a great *Flatus*, giving a high discomposure, which is very familiar to Children, often troubled with Gripes, proceeding from viscid Humors mixed with yellow or green Choler, causing violent Convulsive motions in the Intestines and Stomach, (which are fine Contextures of Nerves) which being first aggrieved by flatulent acrimonious Recrements, do afterward draw the Nervous Fibrils of the Brain into consent, and produce strong and fatal Epileptick Fits; which I have often seen in Children tortured with these severe disaffections, and after Death the *Abdomen* being opened, I have discerned the Stomach and Guts to be highly tumefied, and full of yellow and green Choler, associated with a clammy Matter.

An Epilepsy coming from Worms.

Children and Persons of riper years are often troubled with Worms, which highly afflict the Stomach and Guts with Convulsive motions, which are afterward imparted to the Brain, wherein the Origins of the Nerves are seated, which very much sympathize with those of the Guts and Stomach in their afflictive Diseases.

A Falling-sickness taking its rise from an Ulcered Spleen.

An Epilepsy may be also generated by a hard gangreened Spleen, coming from too great a quantity of first inflamed (and afterward extravasated concremented Blood) some part of which being transmitted to the Cortex of the Brain, vitieth the Animal Liquor and Spirits, making great agitations in the fibrous Compage of the Brain, and afterward in the other Nerves of the Limbs and Body.

An example of this case.

Of this case Learned *Tylingius* giveth an account in *Miscellan. Curiosis ann. 1674, 1675, and 1676. p. 280. Ait ille, Sereniss. ac celsissimi Principis, D. Ferdinandi Alberti Ducis Brunswicensis, & Lunenburgensis filiulus unius anni, Convulsionibus Epilepticis admodum erat obnoxius, cum his itaq; graviter affligeretur, ut tandem vitam cum morte commutaret. Corpus ejus die 27 Jan. 1673. aperui, & lienem induratum, scirrhusum, & fere lapidosum inveni.*

An Epilepsy proceeding from a Virulent Seminal Liquor.

A Falling-sickness may be also produced by a quantity of Genital Liquor, long lodged in the Seminal Vessels, or Prostates, wherein it acquireth a virulent nature, communicated to the Blood, carried by several Vessels to the Cortex of the Brain, where it infecteth the *Succus Nervosus*, giving a great annoyance first to the tender Fibrils of the Brain, and then to the Nerves of the Body, (which are a continuation of them) causing Epileptick Fits, and Death.

A Per-

A Person of Honor having frequently indulged Venereal Embraces, was sensible of the meanness of this natural act, did addict himself to a chaste and abstemious life, whereupon he grew Vertiginous, and afflicted with Epileptick Distempers, attended with a tremulous motion of his Tongue, Convulsive agitations of his Head, (after the manner of a Rotation) a paleness of his Face, and dimness of his Sight; so that after few days, his more Noble and Divine Part quitted his Body; And afterward the lowest, middle, and highest Apartment being opened, all the *Viscera* appeared to be found, only the Vesicular Cells were found full of virulent Seed, the cause of his Epileptick Fits.

An Instance of a Gentleman dying of an Epilepsy.

The Indications (that relate to this Disease) are Curatory, which have regard to the Fit, or Preservatory, which have respect to the Cause of the Disease.

The Indications of an Epilepsy.

As to the first, Purgatives, Vomits, and Bleeding have no place, as giving too great a trouble, and overmuch debilitation to the sick Patient when very weak: So that then the most proper Medicines in this condition, are good Cephalicks and proper Specificks, which compose the enraged, and fortifie the weakned Animal Spirits, and rectifie the Animal Liquor, the subject of them. Such are fetide Medicines (which are highly efficacious in Epileptick Fits) impregnated with Volatil or Armoniack Salt, and with Vitriolick Sulphur, as Oyl of Amber, or with other Volatil Spirits, of Harts Horn, Spirit of Sal Armoniack, either of it self, or succinated, Spirit of Blood or Soot, or Tincture of Castor, Compound Spirit of Lavender, Compound Briony Water, Comp. Pæony Water, &c.

As to the Curatory Indication Purgatives and Vomitories are not proper in this Disease: Cephalicks and Specificks are most laudable in a Falling-sickness.

And as to the Preservatory Indication, which regardeth the taking away the Cause of this Disease, it is principally founded in the rectifying an ill mass of Blood, and Nervous Liquor, which depend much upon the laudable Constitution of the *Viscera*, and chiefly upon that of the Brain, and the good disposition of the Animal Spirits.

The Preservatory Indication is founded in the rectifying an ill mass of Blood.

So that the ill Diathesis of the Blood and *Viscera* is taken away by Vomiting, Purging, and Bleeding, which though they do not perform the Cure alone, yet they prepare the *Viscera* and Blood, and Nervous Liquor, by taking away their noysom Recrements, whereby the Specifick Medicines, can more powerfully exert their vertue, upon the *Viscera*, being deobstructed, and the Blood and Nervous Liquor being depurated; whereupon the discomposed Animal Spirits, and Convulsive motions are calmed, and by degrees the Epileptick Fits are first alleviated, and at last wholly conquered, and Nature restored to a salutary condition, which I have often seen by the Blessing of the Supream Physician upon methodical Prescription and Application of proper Medicines.

Specificks (which highly speak an advantage in the Cure of this Disease) are numerous, viz. Amber, Castor, Coral, Camphor, Ung. *Alcis*, a Humane Skull, Mistletoe of the Oak, or Apple-tree, Roots or Flowers of Pæony, Roots of Valerian; The Leaves of Rue, Lavender, the Flowers of Time, Lily of the Valley, Betony. Preparations made of Swallows, Daws, &c.

Specifick in order to the Cure of this Disease.

These Medicines work by secret qualities, and it is very difficult to determine the manner of their Operations, in taking away the causes of this Disease, which I humbly conceive, do consist much in over-fermentative Elements, in Nitro-sulphureous, and sometimes Vitriolick sharp Particles of the Blood, vitiating the *Succus Nervosus*, causing the Falling-sickness as it is received into the fibrous Compage of the Brain, and Plexes of Nerves; whereupon

Medicines in this Disease work by secret qualities.

The Cure of
this disaffec-
tion is per-
formed by
sweetening
the Blood.

Corroborat-
ing Cepha-
licks very
proper to
strengthen
the Brain.

Purgatives
may be given
if the Patient
be strong.

Vomitories.

Cephalick
Apozemes.

Bleeding pro-
per in a Ple-
thorick Body
labouring of
an Epilepsy.

Topicks may
be applied in
the Fit.

whereupon they grow very unquiet and Convulsed; and the Medicines adapted by Nature to the Cure of this Disease, do sweeten the Acrimonious Particles of the Cristalline Liquor of the Blood (the *Materia substrata* of Nervous Juice) and give an allay to its Nitro-sulphureous parts, by reducing it, and the *Succus Nervosus* in some degree to a laudable Constitution; whereupon the opposite Elements of these various Liquors, are brought to such a Mediocrity, as to produce a due Fermentation, not offending the system of tender Nerves in the Brain, and Plexes in other parts of the Body: And Cephalick Medicines have not only a power to dulcifie the sharp parts of the Blood, and exalt the gross saline Particles (thereby giving a check to the over-fermentative principles of the Blood) but have also an astringive faculty to corroborate the loose Compage of the Nervous Fibrils, of which the Brain is chiefly constituted; And by reason its fibrous frame being rendered flaccid by serous Recrements, is disposed for the reception of a *Succus Nervosus* depraved with acid and saline Particles, highly agitating the system of tender Fibrils, therefore Astringent Cephalicks must be of great use, after sweet Medicines have been advised to sweeten and appease the Vital and Nervous Liquor, impregnated with saline and acid parts, and over-acted with Nitro-sulphureous Recrements, raising the said Liquors to a high Fermentation, productive of Epileptick Fits.

To speak more closely to the Cure of this stubborn Disease, I conceive it very proper to advise Purgatives (to the Patient, if strong) of *Senna*, *Agarick*, *Rubarb*, *Mechoacan* *Jalape*: *Hellebore* mixed with *Celaphicks*, as also the greater *Fatide* Pills, or *de Succino*, aut *Pilula Diambra*, *Hiera cum Agaric*. mixed with *Castor*, *Amber*, *Camphor*, quickned with some Grains of *Refine* of *Jalape*, or *Extract* of *Rud.* or *Hellebore*. Vomits may be also advised, made of an *Infusion* of *Crocus Metallorum*, *Salt* of *Vitriol*, or *Mynsicht's* *Emetick* *Tartar* in a few Grains; and in the working of the Vomits, large quantities of *Posset-Drink* may be taken made with three parts of *Small Beer*, and one part *White Wine*, prepared with the *Flowers* of *Pæony*, *Lime*, *Lily of the Valley*, and the like.

And afterward *Apozemes* may be prescribed with the *Roots* of *Valerian*, *Pæony*, the *Leaves* of *Goats Rue*, the *Flowers* of *Pæony*, *Lime*, *Lily of the Valley*, *Betony*, *Sage*, &c.

In order to the Cure of this Disease out of a *Paroxysm*, in a Body abounding with *Blood*, a *Vein* may be opened, which I have advised with good success.

In the *Fit*, the *Convulsed* *Fingers* may be gently opened, and the *Limbs* brought to a straight posture, and that it may be the better effected, they may be anointed with *Oyl* of *Sweet Almonds*, or *Oyl* of *Fox*, *Worms*, &c. as also the whole *Chine* may be anointed with *Palsey Water*, or the *Queen of Hungaries* *Water*, or with *Wine* or *Brandy* in which *Cephalicks* have been infused.

It is very good to anoint the *Nostrils* with *Extract* of *Garden* or *Goats Rue*, *Oyl* of *Amber*, *Spirit* of *Castor*, *Harts Horn*, of *Salt Armoniack* *succinated*, *Palsey Water*, &c.

The *Palate* and *Tongue* may be anointed with *Treacle*, *Mithridate*, *Powder* of *Castor* mixed with the *Juice* or *Water* of *Rue*, *Lavender*, *Lime* *Flowers*, *Lily of the Valley*, &c. or with *Castor*, or *Mustard Seed* powdered and mixed with *Oxymel* of *Squills*.

Suffu-

Suffumigations of *Asafetida*, *Galbanum*, *Mirrh*; with a little of *Amber*, may be received into the Nostrils, with great benefit in the time of the Fit. Suffumigations.

Sternutatories may be administred, made of *Pelitory*, *Maïoran*, *Castor*, of the Seeds of *Rue*, *Cubebes*, *White-Pepper*, to which, if it be not strong enough, a few Grains of white *Hellebore* may be added. Sternutatories.

And out of the Fits, when Vomitories and Purging Medicines have been applied, Powders, Pills, Apozemes, and Julaps may be given.

As first, Powders made of red *Coral*, *Castor*, and the Roots of *Pæony* made up with Syrupe of *Lime-Flowers* or *Pæony*. Powders.

Or a Powder prepared, with *Missetowe* of the *Oak*, *Dragons Blood*, *Opoponax*, *Castor*, to which may be added Powder of a Man's Skull, *Ungul. Alc.* &c.

And if Powders be unpleasant, Electuaries may be prescribed of *Conserves* of *Lime-Flowers*, *Lily of the Valley*, *Betony*, *Pæony*, *Sage* mixed with Powders of *Missetowe*, of the Roots of *Pæony*, *Valerian*, red *Coral*, *Castor*, and with the Roots of *Eryngium* and *Citron Pill* condited, beaten in a Mortar, into the form of an Electuary, with Syrupe of the Flowers of *Lily of the Valley*. Conserves.

Or an Electuary prepared with the *Conserves* of *Rosemary*, *Cowslips*, *Pæony*, *Goats Rue*, mixed with the Powders of the Roots of *Angelica*, *Contrayerza*, *Snakeweed* of *Virginia*, white *Amber*, *Castor*, &c. made into an Electuary with the Syrupe of *Lime-flowers*. Electuaries.

Pills made of *Castor*, of the Roots of white *Briony*, *Pæony*, *Valerian* powdered, with the Syrupe of *Pæony*. Pills.

After the Pills or Powders, a good draught of an Apozeme may be taken, prepared with the Roots of *Valerian*, *Pæony*, *Angelica*, the Leaves of *Goats Rue*, the Flowers of *Lime*, *Lily of the Valley*, *Rosemary*, *Raisins of the Sun*, &c. and sweetned with the Syrupe of *Betony*, or *Pæony*, adding to every draught some drops of the Spirit of *Castor*, or *Harts-Horn*, *Salt Armoniack* succinated, and the like. Apozemes.

Sometimes a decoction of *Sarza Parilla*, *Gniacum*, the Roots of *Pæony*, *Missetowe* of the *Oak*, Flowers of *Lime*, *Rosemary*, and *Sage* may be very advantageous, (after Purgatives have been given) to provoke Sweat, which may be taken for many days.

Amulets may be made of *Castor*, *Galbanum*, *Opoponax*, mixed with the Powder of the Roots of *Pæony*, *Missetowe*, put into a little *Sacculus*, and hung about the Neck. Amulets.

A Plaister composed of *Betony*, *Tacamahaca*, *Caranna*, mixed with the Powder of *Castor*, Roots of *Pæony*, *Valerian*, *Missetowe*, made into a due consistence with *Bees Wax*, may be applied to the *Sinciput* being shaven. Emplaisters.

Some Physicians promise a Cure by Mercurial Medicines, raising a Salivation, but others think it unsafe, because it highly offendeth the Nerves, before debilitated by Convulsive motions in Epileptick Fits, and if a Salivation be attempted, it must be done in robust fowl Bodies, and afterward a Diet-drink must be advised of *Sarza Parilla*, *Gniacum*, and of the Roots of *Valerian*, *Pæony*, of the Flowers of *Lime*, *Lily of the Valley*, *Raisins of the Sun*, &c. this Decoction may be taken three or four times a day for a Fortnight, or three Weeks, as an Excellent Sudorifick to discharge the Venenate Nature of the Epilepsy, and Mercury. Mercurial Medicines weaken the Nerves. A Salivation may be raised in a strong and fowl constitution of Body, Diet-drink is proper in and after Salivation.

Minerals pro-
per in an
Epilepsy.

And I farther conceive, that *Antimonium Diaphoreticum*, and other Preparations of Antimony may be very beneficial in the Cure of the Scurvey.

Purging and Diuretick Minerals may be proper in this Disease as they refine the Blood, which is very conducive to the Cure of it.

And Fontanels made in the Neck, between the Shoulders, and in the Arm; as also Blistering Plaisters applied to the Neck, between the Shoulders, to the inside of the Arms, Thighs, and Legs, are of great use in this Malady, as they discharge the vitiated Particles of the Blood, and Nervous Liquor, the cause of an Epilepsy.

P A H C

C H A P. LXXII.

Of the Convulsive Motions of Children.

Children are more obnoxious to Convulsive Motions, than those of more mature age, by reason the fibrous Compag of their Brain is more weak and tender, as not being come to due perfection; so that the ill fermentative Elements of the Blood, infecting the nervous Liquor, may easily annoy the most sensible and fine frame of Nerves (seated in the highest, middle, and lowest Apartment) which are unable in Children to oppose the assaults of turbulent, saline, and sulphureous Recrements; whereupon this terrible Malady of Convulsive Motions is more familiar to Children than persons of greater age, who are most liable to them in the first Month after their Birth, or about the time of breeding Teeth.

Convulsive motions are familiar to Children.

Children, (being of an ill constitution of Body) till they come to be Two years old, are often afflicted with Convulsive Motions (distorting their Eyes, Lips, and Face) which sometimes make great concussions of the Arms, Thighs, Legs, and all Muscular parts of the Body; by reason sometimes the Origins, other times the Body and Plexes, and extremities of the Nerves too, are tortured with great storms of Convulsive motions, which are called universal, as they infect all parts of the Body, which striketh terror into the beholder.

Convulsive motions affect various parts

This Disease is most afflictive of Children upon a double account, First, because their Nerves are endued with a laxe Tone, and are easily thrown into irregular Motions, upon an immoderate afflux of nervous Liquor.

The first reason why Children are more subject to this Disease.
The second reason:

The Second Reason may be, because Children have an ill mass of Blood, as wanting Respiration in the *Uterus*; whereupon the Blood having but a slow motion, for want of Air, is not well depurated from Recrements in the Colatories of the Liver, Kidneys, &c. so that it groweth gross, and saculent, as often oppressed with saline and sulphureous Particles, which vitiate the Animal Liquor and Spirits, and highly discompose the tender systeme of Nerves, seated in the Brain, *Viscera*, Muscular, and Membranous parts of the whole Body.

The impurity of the Blood (vitiating the *Succus Nervosus*) which is contracted in the *Uterus*, plainly appears, because in the Month, many Red spots, commonly called the Red Gum, do beset the *Cutis*, and are the Efflorescence or foul parts of the Blood (separated from the more refined in the cutaneous Glands) transmitted through the excretory Ducts into the *Cuticula*; And if the coming out of these Recrements (somewhat resembling the Measles) be stopped; these foul Humors have recourse to the Glands of the Palate and Tongue, wherein they produce the *Apthæ*, which are small Ulcers of the Oral Glands (discharging the foulness of the Blood) which being cured by astringent Medicines, repel the serous and saline parts of the Blood; whereupon they having a recourse to the Brain, do spoil the Nervous Liquor, and make the Animal Spirits very unquiet, productive of Convulsive motions, beginning in the upper Apartment, which are afterward imparted to the other parts of the Body.

The Blood of *Embryos* (being vitiated in the Womb) is sometimes thin and serous, and other times more gross and viscid, which do both participate

The Blood of Embryos is depraved in the *Uterus*.

The Blood is
debased as a
secretion is,
not duly
made in the
various
Glands, both
of the *Cutis*
and *Viscera*.

The manner
of Convulsive
motions.

The First
head of Con-
vulsive moti-
ons.

The effe-
vescence of
the Blood, is
very much in-
creased by ill
Air.

pate of divers kinds of preternatural Salts and Sulphurs, which being of a Fermentative nature (as consisting of Heterogeneous Elements,) endeavouring to subdue each other) are very much exalted in Children presently after the Birth, by the nitrous Particles of Air; whereupon Nature being highly aggrieved by the disputes of contrary Principles of the Blood, endeavoureth (when they cannot be mutually reconciled by a happy harmony) to throw them from the Center to the Circumference by greater and smaller Arteries, terminating into the cutaneous Glands, wherein the offensive Recrements being severed from the more benigne and vital parts of the Blood, are discharged by excretory Ducts into the *Cutis* and *Cuticula*, which giveth a great ease and repose to Nature, and often prevents Convulsive motions; and the Blood is often oppressed with so great a quantity, or so ill a quality of ill Humors, that Nature is not able to make a secretion of saculent from its more profitable parts in the cutaneous Glands, or those of the Kidney, Liver, and other Colatories of the Blood; whereupon the Blood is transmitted from the Heart, by the ascendent Trunk of the *Aorta*, and internal Carotide Arteries, into the Cortical Glands of the Brain, wherein it tainteth the nervous Liquor, which is first carried into the Extremities of the nervous Fibrils, lodged in the *Cortex*, and afterward into the fibrous Compag of the *Corpus Callosum*, *Fornix*, *Corpora Striata*, *Medulla oblongata*, *Spinalis*; and thence by many pairs and plexes of Nerves, into all the *Viscera*, and Muscular parts of the Body, wherein the *Succus Nervosus*, and Animal Spirits being acted with flatulent heterogeneous, elastick Particles, do unnaturally puff up the Filaments of Nerves, and render them unquiet, till they have quitted their load by many violent concussive motions; which I humbly conceive are performed after this manner, by various expansions, and contractions of Nerves, wherein the restless Animal Spirits (residing in the Nervous Liquor) infested with turbulent elastick parts, do insinuate into the narrow Interstices of the Filaments (constituting the Nerves) and enlarge their spaces, and puff up the body of the Nerves; whereupon their Filaments being sensible of their burden, do highly contract their enlarged Interstices, to expel the unquiet Animal Liquor and Spirits, and to reduce themselves to their former posture and repose, as most agreeable to nature.

The causes productive of Convulsive motions, may be chiefly reduced to Two Heads, the First may be whatsoever doth raise the immoderate Fermentation of the Blood, which may proceed in sucking Children, from the Heterogeneous parts of the Nurses Milk, endued with nitro-saline, or sulphureous Elements, or from too large a quantity of Milk, received from the Breast into the Ventricle of the Child, endued with acide saline Particles, vitiating the concoction of the Aliment, which being conveyed through several kinds of Milky vessels, into the mass of Blood, which is rendred highly fermentative by contrary principles, proceeding from the ill concocted Chyle, which being associated with the vital Liquor, is transmitted by the carotide Arteries into the Glands of the *Cortex*, wherein it infecteth the *Succus Nervosus*, and its more refined parts (the Animal Spirits) with elastick flatulent Particles, highly discomposing the fibrous Compag of the Brain, and other parts of the Body, with violent agitations.

As to the Second Head, or cause of Convulsive Motions, the effervescence of the Blood is also much intended by the heat, and ill qualities of the Air, and by the changes of the new and full of the Moon, which do promote the undue Fermentation of the Blood, chiefly founded in Heterogeneous Particles,

ticles, and different Elements, producing great Contests, and undue intestine Motions in the Blood, which being transmitted to the Brain, confound the Animal Liquor and Spirits, and give a high disturbance to its fine contexture of numerous Fibrils, putting the First into various irregular motions, which are afterward transmitted into the systeme of Nerves, sometime seated in one place, and othertimes in another.

Convulsive motions may also proceed from Worms and sharp Humors, vellicating the tender Fibrils of the Intestines, which draw into consent the Plexes of Nerves lodged in the Mesentery, and other parts of the Body.

Convulsive motions proceeding from Worms.

But the Concussions of the Muscular parts of the Face, Limbs, and Trunk of the Body, have their Origen chiefly from the great agitations of the fibrous contexture of the Brain, and seldom from the disaffections, obstructions, and ill coctions of the *viscera*, by reason when the lowest and middle Apartments of many young Children have been opened, and a great inspection made into the *Viscera*, they have found them very sound, and afterward the Skull having been taken off, and the Processes of the Brain viewed, they have been discovered to be immersed in serous Liquor (full of saline and acide Particles) taking away the bounty of the *Succus Nervosus* and Animal Spirits, and rendring the tone of the fibrous Compag, to be very laxe and unable to resist the ill affections of the nervous Liquor, whence ensue diverse unnatural motions of the Fibrils of the Brain, and nervous Plexes of the *Viscera*, and muscular parts of the Body.

Convulsive motions are originally derived from the Brain.

And farthermore, another reason may be offered, that the Blood and serous Liquor infecting the Brain, are a great cause of Convulsive motions; by reason, Fontanels in the neck, and blistering plaisters applied to it, and Leeches set under the Ears, do take away much of the serous Humors, oppressing the Brain, and divert the motion of Blood, which are experimentally found very conducive to the alleviation and Cure of Convulsive motions in Children.

The reason why Convulsive motions do flow from the Brain.

Thus (*pro modulo meo*) I have given a History of Convulsive motions that torture Children, chiefly in the Two or Three first Months, arising out of an ill mass of Blood contracted in the Womb, consisting in Heterogeneous and contrary Elements, raising a high fermentation in the vital Liquor, which afterward infecteth the *Succus Nervosus* and Animal Spirits, with nitro-sulphureous, flatulent, and elastick Particles, causing expansive and contractive motions in the nervous Filaments of the fibrous Compag of the Brain, and other Plexes of Nerves, seated in the *Viscera*, Muscular and Membranous parts of the Body, which often prove fatal; And though nature be so strong as to conquer these terrible motions in the first Months, yet she is obnoxious afterward to great danger, in reference to violent Convulsive motions (associates of a Fever) and proceeding from the breeding of Teeth.

All Children having Fevers in breeding of Teeth, are not always afflicted with concussions of muscular parts, as having oftentimes good Constitutions, and a laudable mass of Blood, and a well-disposed Animal Liquor, and Spirits, and a firm tone of the Systeme of Nerves; whereupon they are not obnoxious to Convulsive motions.

Convulsive motions proceeding from Fevers, produced by pains in the breeding of Teeth.

But the great pains of Dentition, in an ill habit of Body and laxe Compag of Nerves (I humbly conceive) are the immediate cause of a Fever, and Convulsive motions, proceeding from an Inflammation of the Gums, produced by Blood, stagnated in the Interstices of the Vessels, tumefying the said parts, and compressing the branches of the Fifth pair of Nerves (seated about the roots of the Teeth) offended also with saline and acide parts of

The reason
why Children
are very much
disturbed in
Dentition.

ferous Humors, vellicating the nervous Fibrils, endued with a most acute Sense. And the Teeth themselves enlarging their dimensions in Dentition, do squeeze the Nerves, and highly discompose their tender frame by their hard substance, which growing more and more in height, do compress and cut the Membrane (encircling the Gums) which is a contexture of nervous Fibrils, and is derived (as some will have it) from the *Dura Meninx* of the Brain; so that this fine integument of the Gums is a composition of nervous Fibrils, which being squeezed, and cut by the rise of the Teeth, growing upward, must necessarily produce great pain, and often Convulsive motions, drawing the fibrous Compage of the Brain, and muscular parts of the Eyes, Face, Lips, Limbs, and *Viscera* into consent, attended with violent Vomitings, Diarrhæas, Lypothymys, Syncopes, &c. which are very terrible to behold in young Children, not able to express themselves.

The Fever attending the breeding of Teeth, is produced by great pain, the associate of an Inflammation, proceeding from Blood settled in the Gums, which maketh a great effervescence in it, of which some part (endued with heterogeneous fermentative Elements) being returned by the Veins to the Heart, causeth a Fever, partly taking its rise from the over-hasty motion of the Blood, made by the Convulsive motions of the Muscles, violently compressing the Arteries.

And Children are not only subject to Convulsive motions in the Two or Three first Months after their Birth, and in the time of breeding of Teeth; but also in other years of their Minority, which is chiefly derived from an ill disposition of Blood, consisting in heterogeneous fermentative Elements, which having recourse to the *Cortex* of the Brain, doth fill the *Succus Nervosus*, and the Animal Spirits, with flatulent elastick Particles, producing various agitations of the Nerves, caused by the repeated dilatations and contractions of their Filaments, acted with many grand efforts, to discharge offensive Matter, giving a high disturbance to nature.

The Blood is
the cause of
Convulsive
motions, as
spoiled by ill
Diet.
The Blood is
corrupted by
the ulcered
Glands of the
Viscera, pro-
ducing Con-
vulsive moti-
ons.

The Blood, the chief antecedent cause of Convulsive motions, is debased by ill Diet, by Aliment hard of digestion, or by Milk, degenerating into a Curd, by the acide Ferment of the Stomach; whereupon it rendreth the Milk Acide, and sometime the Chyle is corrupted by bilious Recrements, and an ulcerous Matter derived from the Ventricles, or putrefied Glands of the Mesentery. The Blood also is corrupted in its passage through the ulcered Glands of the Spleen, Liver, Pancreas, Kidneys, or the putrefied substance of the Bladder, *Uterus*, *Diaphragme*, *Pleura*, *Mediastine*, Lungs, &c. whereby the vital Liquor being vitiated by a purulent Matter, is carried up through the Carotide Arteries into the Cortical Glands, wherein the nervous Liquor and the Animal Spirits become infected, and produce great, disorderly motions in the fibrous Compage of the Brain, and the plexes of Nerves, belonging to the *Viscera*, Muscles, and Membranes.

The ill mass of Blood is rendered more fermentative by ill Air in Fenny ground, by the heat of the Sun, and by changes of the Moon, and by the malignant influences of the Planets, which do debase the *Succus Nervosus* and its Spirits, and render them turbulent and unquiet; so that they discompose the tender Filaments of Nerves, and put them upon violent and unnatural agitations, highly afflicting the whole Body.

Having given an account of the unpleasant Scenes of this Disease, consisting in various storms of convulsive motions of several parts of the Body, my Taske at this time is to propound a means how these Tempests may be allayed, that a pleasant calm may ensue.

The

The Cure of this Disease requireth a good method of Physick, and the care of a Learned Physician prescribing proper Medicines; and by reason Blood hath a great share in the cause of Convulsive motions, Three or Four Ounces may be taken away by the application of Leeches to the Jugular Veins, and afterward Cephalick Powder may be advised, made of Pæony roots, Mistletoe of the Oak, Coral, Pearl, and the like, given in a spoonful of a Cephalick Julape, prepared with Black-Cherry Water, or Water of Lime-Flowers, Lily of the Valley, Pæony, Rue-water, to which may be added a small quantity of Compound Pæony, or the Antiepileptick water of *Langius*, near akin to the former, and let it be sweetened with the Flowers of Lime, Pæony, or Lily of the Valley.

Applications of Leeches to the Jugulars are very proper. Cephalick Powders may be given in Cephalick Waters.

If the Child Suck, Cephalick Medicines may be given to the Nurse, made of the Roots of Pæony, and the Seeds of Goats Rue, and Caraway boiled in Posset-drink. As also an Electuary made of Conserve of Lime-Flowers, Lily of the Valley, Sage, Pæony; to which may be added the Powder of Mistletoe of the Oak, Pæony roots, Castor, made into a due Consistence with the Syrupe of Lime-Flowers, or Lily of the Valley; drinking after it an Apozeme, prepared with the Roots of Angelica, Pæony, Flowers of Betony, Rorismary, Lime, Lily of the Valley; and after its strained, it may be sweetened with the Syrupe of Pæony, or Cowslips.

Cephalicks may be advised for the Nurse, if the Child Suck.

Powders may be advised for the Nurse, composed of the roots of Valerian, White Amber, Mistletoe of the Oak, of the hoof of a Bufalo, Castor, &c. mingled with White Sugar, and given in a spoonful of the Apozeme prescribed, drinking after it a good draught of the same.

Powder for the Nurse.

And to an Infant may be given Black Cherry, or Rue Water, mingled with Compound Pæony, or Compound Briony-water; or with some drops of Spirit of Lavender, or Spirit of Hartshorn, and the like, sweetned with some Cephalick Syrupe.

A Cephalick Julape for a Child.

Amulets of the roots of Pæony, Castor, of the shavings of the hoof of a Bufalo, mixed with Oil of Nutmegs by expression, may be hung about the Neck of the Child, troubled with Convulsions. If the Infant be actually in a Fit, a blistering Plaister may be applied to the Nucha, or to both sides of the Neck.

Amulets.

Blistering Plaisters are very proper in Convulsive motions.

The Cephalick Plaister without *Euphorbium*, or of *Galbanum*, may be applied to the Feet.

The Powder of *Gutteta*, according to *Rivier*, or one compounded of a Humane Skull, of Pearl, of the hoof of a Bufalo, &c. may be given in a few grains in the following Julape, made of Black Cherry, simple Pæony, or Goats Rue-water, mingled with a small quantity of Antiepileptick Water of *Langius*, and sweetened with the Syrupe of Lime-Flowers.

The Powder of *Gutteta*.

The roots of Valerian, Pæony, Lime-Flowers, &c. may be infused in Canary, and being strained off, may be given in a very small quantity, with White Sugar-candy; or a Distillation may be made (in a Glass, retort with the heat of Sand,) of the roots of Valerian, Pæony, Lime-Flowers, vitriol of *Hungary*, the Skull of a Man in Compound Pæony water, and the distilled water may be given in a small quantity, sweetened with Syrupe of Betony, or Lime-Flowers; or if it seem to be too strong, it may be allayed with the simple water of Pæony, or of Lime-Flowers, or of Lily of the Valley.

Infusions of Cephalicks.

Some of the Gall of a Sucking Puppy, taken in a small quantity of simple Pæony-water, or of Lily of the Valley, may be very proper in Convulsive Fits.

Oil

Bathing the
Chine with
Spirits, or
Oil, is of
great use.
Leeches ap-
plied behind
the Ears are
good in Den-
tition; As al-
so blistering
Plaisters.
Anodynes and
Narcoticks
are good in
violent pains
of the Teeth.
Medicines
good for to
destroy
Worms.

A Plaister
may be appli-
ed to the Na-
vel in this
case.

Oil of Castor, Amber, mixed with the compound Spirit of Lavender, may be very proper to anoint the Chine of a Child, afflicted with Convulsive motions.

In Convulsive motions, proceeding from breeding of Teeth, Blood may be taken away by Leeches set behind the Ears, and Blistering Plaisters may be applied to the *Nucha*, or sides of the Neck, and Anodynes, and Narcoticks may be used in violent pains of the Teeth; whereupon the Gums may be rubbed, or cut with some sharp instrument, to make way for the eruption of Teeth.

In reference to Convulsions, coming from Worms, Rubarb infused in Wine, Beer, or Ale may be proper, or some grains of Calamelanus, given in extract of Aloes; or with Rubarb, mixed with some very few grains of Jailape. In a Child of a strong Constitution, and of some years, Wormseed, or Salt of Prunel, Tartar, or any bitter, or salt Medicine will destroy Worms.

A Plaister made of Colocynth, Aloes macerated in juyce of Wormwood, the Gall of an Ox, all mixed and embodied with Bees-wax, may be applied to the Navil of the Child.

CHAP.

C H A P. LXXIII.

Of the Palsey.

THE noble Compage of the Brain being a systeme of numerous fine Fibrils, branched through the *Cortex*, *Corpus callosum*, *Fornix*, *Corpora striata*, *Nates*, *Testes*, *Medulla oblongata*, (*Cerebellum*, and its Processes) and through the *Medulla Spinalis* as an elongation of the Brain.

These innumerable minute Fibrils of the Brain, *Cerebellum*, and *Medulla Spinalis*, being the constituent parts, are framed of many small Filaments, whose Interstices are receptive of the Animal Liquor and Spirits, by whose spirituous and elastick Particles, the Fibrils are rendred plump, tense, and fit to exert the acts of Sense and Motion, which are also imparted to the Nerves of the whole Body, as so many outlets of the Brain, and the continuation of its fibrous Compage, the first Origen and rudiment of all nervous Divarications, overspreading, and invigorating all the Apartiments of the Body, with their select Liquor, and their more refined Particles, giving Sensation, motion, and nourishment.

The Faculties relating to the said Operations, are lessened, depraved, or abolished, by the errors of the Brain, as being a systeme of innumerable Fibrils, containing the nervous Liquor and its Spirits, giving vigor and tenseness to the fibrous frame of the Brain, and its appendices, which are chiefly hurt, in reference to Sense and Motion, in Two disaffections, either as they are depraved by Convulsive motions, or when pain ariseth in point of Sense; or when the Functions of Sense and Motion are very much lessened, or abolished in a Palsey, causing an impotency in the Limbs, when the fibrous parts of the Brain, and Limbs, lose their vigor and tenseness.

A Palsey may admit this description, That it is a resolution, or relaxation of the fibrous Compage of the Body, proceeding from defect of a due tenseness of the nervous Filaments; whereupon the Faculties of Sense and Motion cannot exert their due operations, in some, or all parts of the Body.

A resolution happens to the nervous parts, when the *Succus Nervosus*, and its spirituous Particles are denied an access to the fibrous parts of the Brain, *Cerebellum*, and *Medulla Spinalis*; or when the Animal Spirits losing their due volatil, or elastick parts, do not influence the Nerves with due Spirits, and Tenseness, especially when they are affected with high Narcotick steams, which despoil them of their laudable temper and tone.

The motive Faculty is impeded, or abolished, by reason the Origenis of the Nerves, are obstructed in the *Cortex*, or their progress in other Processes of the Brain, *Cerebellum*, or *Medulla Spinalis*, or in the Trunks of the Nerves, and their diverse Plexes, and divarications.

The origination of the Nerves, may be obstructed by the grossness of the *Succus Nervosus*, as not being capable to be received into the beginning of the Interstices, relating to the nervous Filaments, constituting the body of the Nerves.

The grossness of the nervous Liquor may arise from a thick faculent albuminous part of the Blood, the *Materia substrata* of the *Succus Nervosus*; or when the cortical Glands being not well disposed, as having too large ex-

The Fibrils of the Brain and *Cerebellum*, are composed of many Filaments.

In the exercises of Sense and Motion, the Fibrils are rendred tense.

The lessened, or abolished, or depraved Functions, come from errors of the Brain.

The Function of Sense or Motion, are lessened, or abolished in the Palsey. The description of a Palsey.

The cause of the resolution of the Nerves.

The motive Faculty is hindered, when the Origen of the Nerves is obstructed.

The Origen of the Nerves may be stopped by a gross nervous Liquor.

The cause of a gross nervous Liquor.

The Origins
of the Nerves
are straight-
ned by the
Tumors of the
adjacent
parts.

The progress
of the Fibrils
may have
their Fila-
ments over-
close.

The solution
of the unity
of parts may
be a cause of
a Palsey.

A Palsey of-
ten succeedeth
an Apoplexy.
The cause of
the Palsey,
how it is
more or less
universal.

The cause
why Sense re-
maineth when
motion is ta-
ken away.

The Com-
pression of the
*Corpora Stri-
ata* hinder the
progress of
the Animal
Liquor.

The seat of
the Palsey.

travagant Vessels or Pores, are not able duely to percolate the more thin, mild Particles of the Blood, from its more gross parts; whereupon the thick Animal Liquor is not capable to insinuate it self into the Origins of the fibrous parts of the Brain, which are also rendred too close and straight, by the swelling of the neighbouring parts, coming from the cortical Glands, by a quantity of extravasated Blood in Inflammations, or of serous Recrements (in a Hydrocephalus, in a Hydropick constitution of the Brain) compressing the Origins of the nervous Fibrils in the ambient parts of the Brain.

And not only the Origins of the minute nervous Fibrils in the *Cortex*, but the progress of more large Fibrils (in the *Medulla oblongata*, and *Medulla Spinalis*) may have the spaces of their Filaments so closely conjoyned to each other by a quantity of Blood, or Pus, or by the tumors of the adjacent parts, that the current of the Animal Spirits is intercepted; whereupon the adjoining Nerves grow flaccid, and unfit for Sense and Motion.

A Palsey also may arise from a Solution of the unity of parts, when the fibrous Compage of the Brain is wounded, or affected with a great blow, or by Concussion, when the order of the fibrous parts of the Brain is perverted, as it hath the Fibres too much separated, or too closely united, dashing one against another.

A greater or less obstruction or compression of the fibrous parts of the Brain, often produceth an Apoplexy, Carus, Lethargy, Hemiplegia: and when the Paroxysmes of these Cephalick Diseases are gone, a Palsey often succeedeth, sometimes affecting one, other times both sides of the Body; so that sometimes one or more Limbs, and other times the Limbs of the whole Body, are disabled in point of Motion.

As the matter of the Disease is more or less imparted to the Nerves of the Brain, *Cerebellum*, and *Medulla Spinalis*, so the parts affected are not only rendred destitute of Motion, but of Sense too in some cases.

And if some curious persons be so inquisitive, as to be informed of the reason, why the Sense remaineth where motion is taken away, this may be offered in point of their satisfactions, that Physicians have assigned some Nerves to celebrate the act of Sensation, and others to motion; but if this Opinion be not satisfactory (as being improbable) because all Nerves are endued as well with Sense as Motion; I will presume to give the courteous Reader another Reason, which may seem more probable, that the act of motion is more difficult and laborious, as supposing an action, whereas Sensation intimates only a Passion, which is more easy then the other, and may be performed by a sensible impression, continued from the common Sensory, by the continuation of the coats of nervous Filaments, propagated from the Brain to the *Medulla Spinalis*, and other parts of the Body; But Motion is accomplished by a higher *nixus* of the Nerves, requiring a greater quantity, and more refined Animal Spirits, expanding the nervous Filaments, and rendring them plump and stiff, in order to motion.

The Compression of the *Corpora Striata*, may arise from some extravasated Blood, or serous Recrements, outwardly crouding the Interstices of the Filaments relating to the *Corpora Striata*; whereupon the progress of the nervous Liquor and Spirits being checked, the Nerves grow relaxed, and their motion abolished.

The *Medulla oblongata*, and the elongation of it, the *Medulla Spinalis* may be the seat of the Palsey, when the Fibrils of the said parts are obstructed inwardly by some gross Matter, or outwardly by the compression of some stagnated Blood, or feculent Humors, or by the Tumors of some adjoining parts,

parts; sometimes this disaffection is placed in the Nerves, without the limits of the Brain, *Cerebellum*, and *Medulla Spinalis*, either in the Trunks, or smaller Branches of Nerves stopped by obstruction, compression, or by solution of their unity; Whereupon, the progress of the Animal Liquor and Spirits is interrupted, and the Filaments of Nerves, become loose and flabby, as having lost their tenseness, a requisite condition of the action of the Nerves.

Sometimes this Disease is seated in the Nerves without the Brain.

Immoderate Cold being a great enemy to the nervous, as well as vital Liquor, doth incrassate the Animal Spirits; so that they loose their volatil and elastick Particles, and are rendred unfit to invigorate the Nerves, in reference to Motion.

Cold, as incrassating the nervous Liquor, may be the cause of a Palsey.

The immoderate use of Opiates (which being taken too frequently, and in too great a quantity) doth vitiate the Tone of the Animal Spirits, and its energetick disposition, which is also produced by the venenate Fumes of Minerals; So that Miners working in Mineral Earth, are affected with the steams of Antimony, Mercury, and *Auripigmentum*, or Arsnick, which cause Tumors in the Limbs; as also sometimes a relaxation of the Nerves; whereupon ensueth a paralytick distemper, taking away the use of the Muscular parts, the proper Engines of Motion.

The immoderate use of Opiates may cause a Palsey.

For the most part the Brain is not only affected, but the *Medulla Spinalis*, and sometimes the *Cerebellum* is concerned by serous Recrements (diffused between the Skull and the Coats of the Brain) which afterward fall down and compress the *Fistula Sacra*, or Silver Cord; whereupon Convulsive motions, and a Palsey ensue.

The Palsey may arise from the Compression of the *Medulla Spinalis*.

A young Man being tortured with great pain of the Bowels, and Convulsive Motions, afterward died Paralytick; and his Skull being taken off, a quantity of watry humours gushed out, which was lodged about the *Dura Menynx*, *Occiput*, and *Cerebellum*, some of which fell down to the *Medulla Spinalis*, and the Nerves swam in serous Liquor.

A quantity of watry Recrements may be the cause of a Palsey.

Sometimes the Brain is clogged with a pituitous Humor, and watry Recrements, which afterward are imparted to the *Medulla Spinalis*; whereupon it is rendred tumide, as having its substance oppressed with saculent Matter (extravasated in the Interstices of the Vessels) compressing the Origen of the vertebral Nerves, and producing a Palsey. Of this Learned *Platerus* giveth an instance, *Præti. Lib. 1. Cap. 2. Part. 2.*

Pituitous and serous Recrements imparted to the *Medulla Spinalis*, are sometimes a cause of the Palsey.

A pituita (Ait ille) seu excremento cerebri aqueo, seroso, frigido, humido, cerebrum irrigante, vel nervorum omnium principium premente, uti Apoplexiam, quæ totius corporis resolutio, generari, sic si hoc in nervis accidat Paralyfim fieri censemus. Talis enim humor a cerebro in Apoplexia, quam prius procrearat, excussus, vel sine ea profluens, non per Dorsalem Medullæ aut nervorum substantiam, sed vel cavitatem dorsi vertebrarum dorsalem Medullam continentem descendens, illicque vel circa principium aut progressum illius subsistens; vel ulterius per ductus, quos nervorum paria a dorsali Medulla progressa, circa omnem Connexum undique in corpore permeant, delabens, aut etiam a capite nervorum conjugationum similes ductus sequens, alicubi; circa nervos hærens, quocunq; loco, sive hoc circa dorsalem Medullam, sive nervorum paria aut conjugationes accidat, ea comprimendo, vel irrigando, uti si hoc in cerebro fiat, Apoplexiam, sic si hoc in jam dictis locis accidat, Paralyfim plurimum pauciorumq; partium, prout generalis particularisve nervus afficitur, procreat, cum si copiosus humor eo affluat, angustis illis in locis pondere suo nervos comprimendo spiritui Animali interciperet possit eoq; diutius si crassior & mucosus longiore mora detentus evadat: Præcipue vero quod humiditate sua nervorum substantiam continuo irrigans & adimplens refrigeransq;

eo in loco propriam ipsorum temperiem destruat, & quo minus Spiritu Animali impleri eoque perfrui possint, impediatur: unde & propter inutilem hanc interpositam nervi affecti portionem, reliquo qui ad partes deducitur nervi ductu ad functionem edendam simul inepto facto, resolutionem perfectam, si magna sit læsio, partium quibus hi communicantur sequi necesse est, eamque eo diuturniorem & pertinacior, quo major nervi offensa existit. Quam veram Paralyseos pituitosæ causam esse, intumescendo ex aqueo humore dorsali Medulla, sectione deprehendimus: ut non opus sit obstructionem quandam in nervis, hic, qui solidi sunt, aut ex filamentis confiti, nec cavitatem ullam, quæ humorem illum crassum uti quidam scribunt, admittere possit, excogitare: vel si nervorum hanc humectationem quidem concordant, id tamen hac ratione, quod nervi longiores laxioresque facti, ad motum edendum inepti fiant, cum Nervi partem minime attrahant, fieri asserere.

A Palsey is
sometime
consequent of
other Dis-
eases.

And a Palsey is not only a primary Disease, but also succeedeth others, and very often is a companion, or consequent of a gentle Apoplexy, determining into a *Hemiplegia*, which is a loss of motion in one side of the body, as the offensive humors are discharged into one Medietty of the *Medulla Spinalis*, which consisteth in two parts, separated from each other; that one portion of the spinal Marrow may be affected, and the other unconcerned.

An instance of
a Patient la-
boured of a
Palsey.

An instance may be given of this case in a Patient, an Inn-holder, committed to my care, who long indulged himself in the immoderate Cups of Wine, Brandy, and strong Drink; whereupon he grew very corpulent, as having a Body full of Blood and serous Recrements, which had first a recourse to his Head, and afterward were partly discharged in the Left part of the *Medulla Spinalis*, where the Origen of the Nerves were compressed (as I humbly conceive, by a tumor of the spinal Marrow in the Left side) whereupon followed a *Hemiplegia*, a resolution of the vertebral Nerves belonging to the said side, affecting all the Muscles of it; whereupon ensued a loss of motion in one half of the Body.

Bleeding is
proper for an
Apoplexy.
Afterward
Vomitories,
Purgatives,
with Cepha-
licks were
given; as also
Cephalick
Electuaries,
Vesicatories.
A Palsey is a
consequent of
Convulsive
motions, and
Epileptick
Fits.

In order to the Cure of the Apoplexy, I did often advise Bleeding in the Neck, Arm, Cupping-glasses, Vesicatories, Purgatives mixed with Cephalicks; as also Cephalick Apozemes, Electuaries, &c. whereupon his Apoplexy ceased, and his Palsey much abated, and afterward went he to the Bath, which I conceive was beneficial to him, in order to the recovery of the lost use of his Limbs.

Othertimes a Palsey succeedeth Convulsive motions and Fits of an Epilepsy; so that the peccant Matter was carried into the Interstices of the Fibrils of the Brain, and afterward into the Trunks, and smaller branches of Nerves; which being obstructed by some serous fixed saline Recrements, which first make Convulsive motions, as long as the Nerves are able to act, in order to expel the offensive Matter; and when they are so far debilitated, that they lose their farther *nixus*, the Filaments of Nerves grow relaxed, as not able to make any more opposition. In Convulsive motions also one Muscle, being Convulsed, the other is Resolved, as being wholly at liberty; when the Antagonist is highly disaffected, as not able to balance the opposite Muscle and reduce the part to a tonick motion.

A Palsey
sometime suc-
ceedeth great
pains of the
Stomach and
Intestines.

A Palsey also succeedeth great pains of the Stomach and Intestines, as they both have various branches of Nerves; which hold consent with the fibrous parts of the Brain, as the said Nerves are propagated from it; so that a sharp and offensive Matter, is imparted from the Fibrils of the Cortex, through the several Processes of the Brain to the *Medulla oblongata*, and thence to the Trunk of the *Par vagum*, and by various branches, to the Stomach and Interstices, producing severe pains of the said parts; and sometimes this Mat-
ter

ter is carried from the Spine to the vertebral Nerves, and thence to the upper and lower Limbs of the Body, and also the Stomach, Liver, and Bladder of Gall are very much disaffected with Colick pains.

An Instance of this case may be given of a young Maid, who laboured of a spurious, tertian, intermittent Fever (proceeding from an obstruction of the Liver and Bladder) and then fell into Colick pains, and a paralytick disaffection, which continued the space of a year, and at last she died, afflicted with a *Delirium*, and Convulsive motions. The Palsey first affected the Arms and Head, and afterward descended to the Thighs. This Woman having the *Abdomen* opened, the Liver was found to be over-large, with reference to the Body, and very much obstructed, and the Bladder of Gall filled with gross Black Choler, and the Stomach much distended with Green Excrements, and the Colon full of hard Fæces, and dilated with much flatulent Matter; and the Brain being dissected, a Water was discovered to gush out and follow the Knife; and the same Liquor was discerned to fill up all the space, interceding the coats of the spinal Marrow, where the Fibres, the Origins of the vertebral Nerves were seated; Whereupon, the beginnings of the vertebral Nerves being compressed, the current of the nervous Liquor and Spirits was intercepted, and the Filaments of the Nerves relaxed, and the use of the Arms, Hands, and Thighs lost.

An instance of a Patient dying of a Palsey, proceeding from pains of the Stomach and Intestines.

Persons also obnoxious to Arthritical disaffections sometimes fall into a Palsey, by reason the acide and saline Particles of the Blood, infecting the nervous Liquor, do vitiate its refined Particles; whereupon the Animal Spirits losing their expansive nature, do not invigorate the Nerves; so that they grow limber and unfit for motion, whence ariseth a Palsey.

An Arthritis sometimes degenerates into a Palsey.

Scorbutick habits of Body are liable to this Disease, as having an ill mass of Blood, debased with acide saline Particles, which spoil the albuminous part of the vital Juyce, the *Materia substrata* of the *Succus Nervosus*, which being dispirited, doth not duely invigorate the nervous Fibrils; whereupon arise Tremors in the Limbs, proceeding from faint Animal Spirits, not rendering the nervous Filaments Tense, and apt for motion, whence floweth a Paralytick disposition, which also proceedeth in Cachetick Bodies, from a quantity of ferous Recrements, sometimes inwardly obstructing the spaces of the Filaments, and othertimes outwardly compressing the Origins, Trunks, and Branches of Nerves; whereupon they grow flabby and relaxed, as not receptive of nervous Liquor, and its spirituous tensive Particles.

Scorbutick habits of Body are obnoxious to a Palsey.

A Palsey may also arise *a soluta unitate* from a wound of the Skull and Brain, lacerating sometimes, and othertimes cutting asunder its Blood-vessels; whereupon the Brain is affected first with an inflammation, by a source of extravasated Blood (lodged in the substance of the Brain) which afterward degenerates into a purulent Matter, compressing the fibrous frame of the Brain, and hindring the influx of Animal Spirits into the Nerves, productive of a Palsey.

A Palsey may proceed *a soluta unitate Cranii*.

A Souldier was wounded in the hinder part of his Head with a weapon, not only dividing the Skull, but penetrating the coats into the substance of the Brain, which generated first an Inflammation, and afterward an Abscess; whereupon the Patient complained of a vertiginous disposition, and of a pain in his Right Eye; and afterward was affected with an Hemiplegia of his Right side, and a *Carus*, and Convulsive motions of his Right Arm, the fore-runner of a more fatal storm of death.

An instance of the said case in a Palsey.

The Skull being taken off, a great part of the Brain, was overspread with a fungous Matter, which is very common in wounds, Inflammations, and

Abscesses of the Brain, into which an Incision being made, an Aposteme of the Brain was discovered, and the Right Ventricle distended with a clear ferous Liquor, compressing the nervous Fibres of the Right side of the Brain, and intercepting the progress of the Animal Liquor into the Right medietry of the Spinal Marrow, and Origins of the vertebral Nerves; whereupon ensued a resolution of them, belonging to the Right side.

A Palsey coming from a bruised *Medulla Spinalis*.

A Palsey may also happen upon a wound of the *Medulla Spinalis*, bruising or cutting the Origins of the vertebral Nerves; whereupon the motion of the Animal Liquor and Spirits is checked, in reference to the nervous Trunks and Branches, (propagated from the Spine) so that they grow loose and flabby, wholly indisposed for action.

An Instance of this kind of Palsey.

A Maid being shot into her Back with the Bullet of a Pistol, was immediately sensible of a great pain, and defect of the motion of her Limbs, a Resolution being made from the middle of her Loins to her lower parts, which proceeded from the wound of the Origins of the vertebral Fibres, seated in one side of the Spine, and from a Bullet lodged in the Spinal Marrow, outwardly compressing the beginnings of the vertebral Nerves.

The Patient being dead, a round hole was found penetrating the *Musculi longissimi* and *Sacrolumbares*; and afterward the Spine and its Marrow, wherein was discovered a Bullet, lodged in its substance, and compressing the Origins of the vertebral Nerves.

An ill mass of Blood is the chief antecedent cause of a Palsey.

Having discoursed the continent causes of a Palsey, illustrated by many instances of several cases in this Disease; I will now Treat somewhat of its antecedent causes, of which the chief is an ill mass of Blood, generated by an ill Diet, either of too much Meat, or hard of digestion, or the immoderate drinking of Wine, and strong Drink, and Tobacco, and Fumes, and Metallick Vapours, or vehement Passions of the Mind, making great alterations in the vital Liquor, the *Materia substrata* of the *Succus Nervosus*, which is highly discomposed by the *Sex res non naturales*, some of which are very offensive, producing a kind of *Narcosis* in the Animal Spirits, despoiling them of their brisk elastick nature, thereby rendring the Nerves Laxe and resolved.

The Locomotive Faculty is lessened and abolished by the defect of Animal Spirits.

And the Locomotive power of the Limbs and Body is not only abolished, but also lessened in point of Impotency of motion, proceeding from a defect of Animal Spirits, not fully invigorating the Nerves; hence ariseth a trembling of the Head and Limbs, so that the motive Faculty is not able easily to sustain the weight of the Limb, produced from the weakness of the Nerves, rendring the Antagonist Muscles, not able to balance each others Contractions, and reduce the Limbs to a tonick motion, by containing them in a firm fixed posture; whereupon the weight on one side, so depresseth the Limbs, and the *Nixus* of the Antagonist Muscles, that they are not able to make good their tonick Motion.

The cause of tremulous Motions.

The Limbs grow disordered by various tremulous motions, derived from contrary principles, of the weight of the Limbs, and of weak nervous Fibres, which putting forth their utmost *Nixus*, make different successive agitations, originally flowing from an ill *Succus Nervosus*, not imprægnated with volatil and elastick Particles; whereupon sluggish Animal Spirits, being not endued with an expansive nature, do not render the nervous Fibres plump and stiff.

Many kinds of a Palsey.

There are many kinds of a Palsey, sometimes the Sense is lost and the Motion preserved; and other times the Motion is taken away, and the Sense remanent.

The

The sensitive Faculty is abolished (and the Motive not disaffected) when the Sight, Hearing, Taſt, and Smell, are highly diſcompoſed or taken away, as the Nerves appropriated to the ſaid Senſes, are obſtructed by groſs Recrements, or compreſſed by extravaleſated Blood or Recrements, ſhutting up the ſpaces of the Viſory, Auditory, Taſting, or Smelling nervous Filaments; whereupon the progreſs of the Animal Liquor is ſtopped, and the nervous Fibres (conſigned to the ſenſitive powers) rendered relaxed, and diſabled to accompliſh the operations of the outward Senſes.

In one kind the Sensitive Faculty is aboliſhed, and the Motive preſerved.

The Motion is taken away by the paucity of the Animal Spirits, or rather by the indiſpoſition of them, when they have loſt their tenſive and elaſtick quality, not expanding the Interſtices of the nervous Filaments; ſo that they have not been ſtiff and plump, and thereby made incapable to execute the motive faculty of the Limbs.

The Motion is taken away by the paucity or indiſpoſition of Animal Spirits.

Some have imagined that the Senſe of Touching hath been aboliſhed, and Motion at the ſame time preſerved entire; to which, this reply may be given, That this Hypotheſis wanteth a clear ſtating, whether theſe different operations of Senſe and Motion be meant of the ſame, or of diſverſe parts; if it be underſtood of the ſame, it is improbable, by reaſon that the *Cutis* is the organ of Touching, but not of Motion, which is performed by carnous Fibres of the Muſcles, which are deficient in the Skin, only endued with nervous Fibrils (the inſtrument of Touching) and when they have loſt their Senſation, as it is ſometimes found in Scorbutick Habits of Body, the *Succus Nervofus*, and the Animal Spirits relating to the Coats, are depraved; whereupon the cutaneous Nerves grow flabby and relaxed, and loſe their ſenſe of Touching (as in a paralytick diſtemper) and yet at the ſame time the carnous Fibres of the Muſcles retain their Motion, as their Nerves are rendered Tenſe by the Spirits, and elaſtick Particles of Animal Liquor, invigorating the nervous Filaments, ſeated in the Muſcles, which is taken away in the Limbs, and moſt parts of the Body, upon the compreſſion of the ſpinal Marrow by Blood, or ſerous Recrements, falling down from the Brain in an Apoplexy (whence ariſeth a Hemiplegia, a loſs of Motion in half the Body) or this defect of Motion in the Muſclar parts, may proceed from a wound in, or great blow upon the Spine, in which caſes the current of the Animal Liquor and Spirits is intercepted.

Some conceive that the Senſe of Touching hath been loſt, and Motion preſerved.

As to the Prognofiicks of this Diſeaſe, it is very hard to be cured, as the Brain, Spinal Marrow, and Nerves, are affected; and as a reſolution of one or more parts is made, which is removed with great difficulty, eſpecially if this Diſeaſe be a conſequent of an Apoplexy, Carus, Lethargy, and the like; As the Palsy is cauſed by a deſluxion of ill Humors from the Brain to the *Medulla Spinalis* (where a Paraplegia is produced) and from thence the offenſive Matter ſometimes hath a recourſe to the Brain, as ſome Learned Men will have it; but it ſeemeth more agreeable to Reaſon, that a new Apoplexy is made by a farther ſtagnation of Blood, or other groſs Recrements, (compreſſing the nervous Compage of the Brain) which are brought into the Brain by the carotide Arteries, ſo that the offenſive Matter compreſſing the *Medulla Spinalis*, is not brought upward from thence into the ſubſtance of the Brain.

The Prognofiicks of a Palsy.

The Palsy is leſs dangerous, when only the Senſe or Motion is taken away, and worſe where both are diſaffected, and the danger is greater when the Brain, or *Medulla Spinalis* are obſtructed or compreſſed, which often proveth fatal to the Patient.

A Palsey is hardly cured, which proceedeth from an extraordinary Contusion of any Vertebral, or some other eminent Trunks of Nerves, which doth not only proceed from the Attrition of Nerves, but also from the inflammation of the neighbouring parts by extravasated Blood, coming from lacerated vessels; whence ariseth a Tumor, compressing the bruised vertebral Nerves, and aggravating the Palsey.

A Tremor supervening this Disease, speaketh somewhat of hope, as it denoteth some vigor of the relaxed parts, productive of a tremulous Motion; whereby the progress of the Animal Liquor and Spirits, is in some degree promoted.

And if the resolved Limbs be acted with heat, it giveth some hope of recovery, as it is enlivened in part by Vital and Animal Liquor; if the indisposed Limb do labour of an Atrophy, or hath lost its natural heat, and vivid colour, it speaketh a great difficulty of Cure, because the part affected is destitute of vital heat, and nourishment, which is occasioned by the defect of the *Succus Nervosus*, a main ingredient of Nutrition, as confederated with the Albuminous parts of the Blood, and assimilated into the substance of the part.

A Fever is good in Paralytick Distempers,

In all disaffections of the Nerves, as in paralytick Diseases, flowing from cold, serous, and pituitous Recrements; a Fever is very advantageous (as discharging the offensive Matter, by a free transpiration, and frequent Sweats, passing through the Pores of the Skin) which warms and exsiccates the Nerves; and as to the Fibrils heat enlargeth the narrow spaces of the nervous Filaments, and maketh way for the reception and progress of the Animal Liquor, rendring the Nerves Tense, and disposed for motion.

The methods of a Cure of a Palsey are different, as they succeed various Diseases.

The Cure of this Disease is very various, as proceeding from several causes, speaking different methods and Medicines, appropriated to diverse kinds of this Disease, as it is successive to other Diseases; or proceeding from some evident, or some antecedent, or from procatactick causes.

Bleeding and Purging Medicines are proper, when a Palsey is a consequent of an Apoplexy, Carus, &c.

In reference to a Palsey, supervening an Apoplexy, Carus, Convulsive motion, and the like; which being primary Diseases, (productive of a Palsey) do indicate Bleeding, and Purgative Medicines, mixed with Cephalicks, Clysters made of Emollients and discutients, to which may be added purging Electuaries, Syrupes, &c. As also Cupping-glasses, Vesicatories, Sturnatories, Cephalick Julapes, Pills, Powders, which have been already more largely Treated of in the Cure of an Apoplexy, Carus, &c. And if this paralytick Disease, be not conquered in a Fortnight or Fifteen days; as it groweth radicated and habitual, it relates to a preservatory Indication, which I intend hereafter to propound.

A Palsey proceeding from an evident cause, indicates Bleeding, after a Clyster hath been injected. And then gentle Diureticks and Diaphoreticks may be administered, Diuretick Powders.

A Palsey derived from an evident cause, of a Stroke, Fall, Wound; that the prejudiced part may be restored again, an apertion of a Vein may be proper (as lessening the mass of Blood, and diverting it from the part affected) after an emollient and discutient Clyster hath been administered, and rejected, gentle Diureticks, and Diaphoreticks may be safely advised, to make good the circulation of the Blood, and discharge its serous Recrements, whereby the part aggrieved is eased.

As also Diuretick Powders, made of the Four cooling Seeds, Chervil, Golden-rod, and the like, mixed with Sugar; or a Powder recited in the *Augustan Dispensatory*, drinking immediately after it an Apozeme, prepared with opening and Diuretick Medicines, or vulnerary Diet-drinks.

The dislocated Vertebrae are to be reduced.

Or if a Dislocation be made of the vertebrae of the Spine, they are to be reduced to their natural situation by a dextrous Chyrurgeons hand: And afterward

afterward Balsomes, Liniments may be applied; as also Fomentations, Cataplasmes, Emplastres of *Oxycroceum*, *e Minio*, *e Mucilagimibus*, of *Paracelsus*; and if the Tumor of the Chine remain, resolving and discutient Balthings may be outwardly administred.

An habitual Palsey (depending upon Procatartick and antecedent causes) being considered *in actu signato*, or *exercito*, *in fieri*, or *factum esse*, doth challenge to it self a peculiar way of Cure.

An habitual Palsey claims a peculiar Cure.

As to the Procatartick causes belonging to this Disease, a care must be had of the *Sex res non naturales*, that they may be disposed in good order according to Art.

A respect must be had to the *Sex res non naturales*, in the cure of a Palsey.

And the intentions of a Palsey in relation to its antecedent causes, do denote the goodness of Chyle and mass of Blood, which is effected by a good Diet, and proper Ferments of the Stomach, depending on a laudable Vital, and nervous Liquor, the *Materia substrata*, and subject of the Animal Spirits.

To this intent courses of Physick may be administred, prepared with Cephalicks and Antiscorbuticks, mixed with purging medicines, and after them in a Plethorick Body, Bleeding may be advised, and then Chalybeat Medicines may be taken of Tinctures, Syrupes, Powders, given in Electuaries made of Temperate Scorbutick and Cephalick ingredients, drinking after them a good draught of a proper Apozeme.

Medicines prepared with Cephalicks and Antiscorbuticks; As also Chalybeats are good in this Disease.

Vomitories may be prescribed in a foul Stomack, (opening the obstructions of the Liver, Spleen, Pancreas) made of the infusion of *Crocus metallorum*, Salt of Vitriol, Oxymel, or Wine of Squills, or some few grains of *Mercurius vitæ*, which is not to be given but in robust Bodies.

Vomitories may be advised in a foul Stomach.

Fontanels may be made in the Neck, between the Shoulders, in the Thigh, or Leg, which are very beneficial in this case.

Fontanels very proper in a Palsey.

Ale is proper, medicated with the Leaves of Sage, Betony, Rorismary; as also the Flowers of Lime, Lily of the Valley, Sage, Pæony, Rorismary, Betony, and the like.

And not only the Continent, and Procatartick causes of a Palsey, are to be considered, but the ill habit of the body too, if the Disease groweth habitual, as highly radicated, and in this case a care must be had, that Bleeding and violent Purging be omitted, as Nature is highly weakened by the length of the Disease; so that gentle Purgatives, mixed with Antiscorbuticks, Diureticks, may now and then be given; as also Cephalick Apozemes, Electuaries, prepared with Chalybeats, which do refine the Blood, nervous Liquor, and Spirits, and corroborate the Nerves, which are relaxed, or resolved in this Disease.

The ill habit of the Body is to be considered in a confirmed Palsey. Purgatives, and Alteratives, as Apozemes, Electuaries, are proper for a habitual Palsey.

In a Palsey, proceeding from pituitous or serous Recrements of the Brain, an Electuary may be advised, prepared with the Leaves of Water-creffes, the Flowers of Sage, Betony, Pæony, Rorismary, and Condite Eryngo-roots, Condite Nutmegs, Mace; as also with the Powders of Crabs Eies, Millepedes, and a little of Castor and Amber, made up with Syrupe of Sage-Flowers, or Lavender, drinking after it, a good draught of an Apozeme, made of Sarzaparilla, China, Guaiacum, Sassafras, infused and boiled in fair water; and to the Colature, may be added of the Leaves of Betony, Sage, Rorismary, of the Flowers of the same, which may be aromatized with Mace Nutmegs, &c. and sweetned with Syrupe of Lavender, or Lime-Flowers.

Medicines for pituitous or serous Recrements of the Brain.

Or a Milk-water may be thus prepared; Take of the Bark of Winteran, of the chips of Auranges, and Limons, of each Two Ounces, of the Roots, or Leaves of Cuckowpintle, of the Leaves of Garden Scorby-grass, Water-creffes, Sage, Betony, of the Flowers of Lavender, Sage, Rorismary, Nut-

A distilled Milk-water.

megs, Millepedes, which may be besprinkled, First with Wine, and stand a convenient time, and afterward a large quantity of Milk may be added, and a distillation made in a Rose Still. To every Dose of this distilled water may be added some drops of Spirit of Salt Armoniack succinated, or of Spirit of Hartshorn, Sutt, Blood, &c.

Spirits of Salt
Armoniack
succinated,
or of Hartshorn,
Sutt,
Blood, &c.
Tinctures of
Turpentine,
Antimony, or
Amber, or
Elixir Propri-
etatis.
Bezoar Mine-
ral.

Dr. Willis adviseth Tincture of Mercury, Terebinth, or Tincture of Antimony, or Amber; Elixir proprietatis, or Pæony, &c.

The Powder of the Flesh of Vipers, and of the Hearts and Livers, may be given in distilled waters of the Flowers of Lavender, Sage, Betony, Rorismary, &c.

Bezoar Mineral. Solar. mixed with Powder of Cloves, Nutmegs, Mace; and once in Four or Five days, gentle Purgatives, prepared with Cephalicks, are to be advised.

Trochisci and
Pills.

Trochisci de Mirrha, or Hysterici, as also Pills made of Castor, Amber, Powder of Millepedes, and of the Roots or Leaves of Ground Pine, made into Pills, with Syrupe of Pæony may be beneficial.

Powder of Zedoary, Galangal, Cardamom, Specier. Diambra. may be given in a draught of some Specifick, or Cephalick water; or in the Magistral Milk-water, prescribed above.

Fomentation
of the Chine.

And last of all in this Palsey, proceeding from cold causes, the Spine may be bathed with compound Spirit of Lavender, or the Queen of Hungarys Water, or with Oil of Amber, and the like.

Natural Baths

Natural Baths, which being sulphureous and Bituminous, do heat, dry, and corroborate the Brain and Spinal Marrow, and are very advantageous after universal evacuations have been celebrated.

A Bilious Pal-
sey doth indi-
cate more
milde and
temperate
Medicines.

A Palsey proceeding from Bilious Recrements, oppressing the Brain and Medulla Spinalis, doth indicate more mild and temperate Medicines, as Electuaries, made of Conserve of Lime-Flowers, Lily of the Valley, Peagles, Betony, Fumitory, mixed with Species Diambra, Powder of Red Coral, Crabs Eies, prepared Pearl, Crabs Claws, made into an Electuary, with the Syrupe of Lime-Flowers, or Lily of the Valley, drinking after it a draught of Milk-water, made with the Leaves of Betony, Water-creffes, Brooklime, Ground Pine, Cowslips, Mountain Sage, of the Flowers of Lime, Lily of the Valley, Sage, Rorismary, distilled with Milk in a Rose Still.

Apozemes,

And in this case, an Apozeme may be given made of China, Sarza-parilla, shavings of Ivory and Harts-horn, infused and boiled in Water; in the Colature may be infused the Flowers of Betony, Cowslips, Lime and Pæony, to which being strained, Syrupe of Lime-Flowers may be added.

A Palsey taketh its rise from a Scorbutick indisposition of Body, spoiling the Albuminous part of the Blood, the ground of the Succus Nervosus, and its more refined Particles.

Antiscorbu-
tick Juyces.

This indisposition is regulated by proper Antiscorbuticks, made of the juyces of Garden Scorby-grass, Brooklime, Water-creffes, Auranges, which being depurated per residendum, may be given in a proper Milk-water, made of Antiscorbuticks, and Cephalicks, distilled in a small proportion of White Wine, mixed with a large quantity of Milk, in a Rose Still.

Antiscorbu-
tick Electu-
aries.

Electuaries, made of the Conserve of Garden-Cresses, Chervil, Water-Cresses, Garden Scorby-grass, prepared with the Powder of Egg-shells, Red Coral, Pearl, Ivory, Crabs Eies, made into the Consistence of an Electuary, with the Syrupe of the opening Roots, drinking after it a good draught of a Diet-drink, prepared with China, Sarza-parilla, Ivory, and Hartshorn shavings, Raisins of the Sun stoned, and in the Liquor, being boiled and strained, may be

A Diet-drink.

be infused the tops of Pine and Firre, and the Colature being strained, may be sweetned with the Syrupe of Cowslips, or Lime-Flowers.

Pills made of testaceous Powders, Millepedes, formed into Pills, with Venice Turpentine, may be proper in a Scorbutick Palsey, drinking after it a draught of Diet-drink, made of China, Sarza-parilla, &c. as above. Or a Decoction made of Ground Ivy, and Antiscorbuticks, and Cephalicks, of Mountain Sage, Water-creffes, Brookelime, Flowers of Betony, Pæony, Sage, Rorismary, &c.

Pills made of
Millepedes,
and of testa-
ceous Pow-
ders, &c.
A Diet-drink.

Diaphoreticks may be of great use in this Disease, as Sweats do depurate the Blood and *Succus Nervosus*, produced by Diet-drinks of Sarza-parilla, China, &c. or by testaceous Powders, Spirits and Extracts of Guaicum, Flowers and Spirit of Salt Armoniack succinated, Salt and Wine of Vipers, Diaphoretick Antimony, Bezoartick Mineral, &c. drinking after them a good draught of a proper Diet-drink.

Diaphoreticks
are very use-
ful in a Palsey.

Mercurial Medicines, productive of Salivation, are propounded by some in desperate and habitual Palseys, which method of Physick may prove fatal in weak Bodies; as Mercurial Medicines highly infect the Brain, Spinal Marrow, and Nerves.

Some pro-
pound Mercu-
rial Medicines
in a stubborn
Palsey.

And last of all, when universal evacuations have been administred, Topicks may be applied, made of Spirit of Wine, in which the Flowers of Sage, Rorismary, Lavender may be infused.

Topicks may
be applied
when univer-
sal evacuati-
ons have been
made.

As also Balsomes, mixed with Oil of Fox, Worms, Castor, the Queen of Hungarys Water, with which the whole Spine is to be annointed, and after-ward covered with Flannel.

And at other times, when Ointments are not applied, the Spine and Resolved parts may be invested with several sorts of Furrs, which much cherish the relaxed and weakened Limbs.

The Parali-
tick parts are
to be warmly
clothed, with
Furrs, or the
like.

CHAP

C H A P. LXXVII.

Of the Scurvey.

The Scurvey,
is a kind of
universal Di-
sease

HAVING Treated of many Diseases, relating more particularly to the Head, I will conclude its Pathology with a Disease which may claim the Appellative of Universal, as it not only affecteth the nervous Liquor, and its more refined Particles (the Animal Spirits) but their subject too, the fibrous Compage of the Brain, lodged in the highest Apartment, and all the *Viscera*, the choice householdstuff of the middle and lowest story of the Body.

That the nature of the Scurvey may be rendered more clear, I shall endeavour to give a History of its Subject, Causes, and Symptomes, in order to a Cure.

The First seat
of the Scur-
vey.

As to its Subject (I humbly conceive) it is originally seated in the Stomach, as it taketh its rise from an ill Concoction, producing a crude Chyle, which being not well prepared in the Ventricle, maketh an ill mass of Blood, indisposing the *Viscera*, as not receiving a due percolation in them; whereupon the Blood is debased and depauperated, as affected with gross sulphureous, and saline Particles, unduely exalted, so that the vital and nervous Liquor being vitiated and dispirited, do produce a Complication of Diseases (seated in many parts of the Body) commonly called the Scurvey, an Imperial Malady, attended with a great train of Symptomes.

The Sym-
ptomes of the
Scurvey in
the Head.

In the highest a partiment it produceth great and periodical pains, as now and then affecting the coats of the Brain with a hot and ill mass of Blood, and sometimes Drowfiness, and othertimes Watchfulness, Lightness of the Head, Convulsions, a Palsey in several parts of the Body, caused by an ill *Succus Nervosus*; the companions of this Disease are also Ulcers of the Tongue and Palate, coming from sharp Recrements of the Blood (depurated in the oral Glands) spued out by the excretory Ducts into the skin of the Tongue and Palate, which are often bedewed with a quantity of salival Liquor, causing frequent Spittings, attended with Ulcers of the Gums, looseness of Teeth, and an ill savour of the Mouth, stenchd with corrupt serous parts of the Blood, corroding the Gums, and their ligaments, loosening the Teeth from their repositories; whereupon they grow laxe, and sometimes drop out of the Mandibles.

The Sym-
ptomes of the
Scurvey in
the Thorax.

The parts of the middle Apartment in the Scurvey, are afflicted with great Stiches, and shooting pains of the Sides, and Sternon, arising from sharp Particles of Blood, torturing the *Pleura* and Mediastine. The Lungs also often labour of a great difficulty of breathing, briskly endeavouring by often repeated acts of Respiration, to pump the gross mass of Blood from one Cistern of the Heart, (through the pulmonary Artery and Veins) into the other; whereupon the Heart being often oppressed with too great a source of thick dispirited Blood, is highly discomposed with disorderly pulsations, Palpitations, Lypothymies, Syncopes, &c.

The Sym-
ptomes of the
Scurvey in the
lowest Ven-
ter.

The *Viscera* also of the lowest Apartment, are highly anoyed in this Disease. The Stomach laboureth of nauseousness, belchings, vomiting pains, proceeding

proceeding from sharp, and pituitous, flatulent Recrements, floating up and down in the Stomach, the sad consequents of an ill concoctive Faculty, proceeding from ill Ferments; The Hypochondres are often afflicted with inflations and croakings, which arise from Wind passing down the Guts, often productive of Cholick pains, when its course is intercepted; whereupon the coats of the Intestines are puffed up, and aggrieved by the tensive and elastick Particles of Wind, which always endeavouring to expand themselves, grow impatient, when they are confined within narrow bounds. Sometimes this Disease causeth a Diarrhæa, and other times a Dysentery, coming from a quantity of thin sharp Recrements, solliciting (and corroding) the Intestines, in order to expulsion.

In this the ambient parts and habit of the Body, Severe wandring pains are often felt, proceeding from sharp and serous parts of the Blood and nervous Liquor, torturing the membranous and fibrous parts of the Muscles, and Periostia of the Bones; this Disease is also accompanied with a spontaneous weariness and great weakness of the Limbs, rendring them unfit for motion, which proceedeth from an ill nervous Liquor void of good Animal Spirits, as losing much of their tensive Particles; whereupon the Nerves and carnous Fibres grow flaccide, and faint in their Contractions, so that the Muscles often lose their plumpness, whence ariseth an Atrophy of the whole Body, and the outward parts are beset with spots of various colours, of Red, and Yellow, as the thinner parts of purer Blood, or as mixed with Choler, are carried through the excretory Duets, and settled in the Skin; which is sometimes infested with Tumors, coming from extravasated Humors, and other times with Ulcers, flowing from sharp corroding Recrements of the Blood, and with a Scab or Scurf, derived from the ill gross saline Particles (discharged by the excretory cutaneous Duets) concreted upon, and adhering to the surface of the ambient parts of the Body.

The Symptoms of the Scurvey in the habit and ambient parts of the Body.

Having given an account of the subject and the various symptomes of this Disease, and their Ætiology, I conceive it agreeable to Reason, to shew you the causes of it.

The procatartick cause may be a gross Air in Maritime and Fenny places, as infected with thick and moist vapors, arising out of the Earth, as the Air is poisoned with malignant influences of the Planets; so that the ill Air (mixing in the Mouth with the masticated Aliment) doth very much spoil its concoction in the Stomach; by reason the Air having lost much of its elastick Particles, cannot open the Compage of the Meat, and prepare it for the extracting an alimentary Tincture, which especially happens when the Aliment it self is hard to be concocted, as in Fish salted, and Flesh treated after the same manner, and hardned by Smoak; whereupon most of their succulent Alimentary Matter is dried up by Salt, or extracted by the heat of the Fire and Smoak; so that the Earthy and subtle parts of Flesh or Fish, can give no Aliment, and put the Stomach upon a great trouble, to sever the little Alimentary Particles from the Tartar, in which they are highly and closely confined.

An ill Air is a procatartick cause of the Scurvey.

Gross Aliment is a remote cause of the Scurvey.

Another reason of the ill concoction of Aliment, (making a crude Chyle the remote cause of the Scurvey) are the ill Ferments of the Stomach, endued with over acide, or fixed saline Particles, which spoil the bounty of the Chyle, and make an ill mass of Blood, (as depressed with acide or fixed saline Elements) whereupon it may be inferred, with good Reason, that the material cause of the Scurvy, being a depraved mass of Blood, must neces-

The ill Ferments of the Stomach are remote causes of this Disease.

farly indispose all the apartments of the Body, and the various integuments, encircling them, and all parts, lodged in their warm Bosome.

The source of this Disease must be in the noblest Liquors (passing the whole which are the vital and nervous juyce, giving Life, Heat, Sense, Motion, and Nourishment.

III Blood is an antecedent cause of the Scurvey.

That the Blood hath a great share in the production of the Scurvey, may be made appear by its high ebullition, and fermentation, and by various spots and little Tumors, besetting the Skin, and a thick high coloured Urine, much resembling Lees of Wine in colour and consistence.

A vitiated nervous Liquor is another cause of it.

And not only an ill mass of Blood, but a depraved nervous Liquor (often infected by it) very much contributeth to the generation of this Disease, declared in the most troublesome pains of the membranous, nervous, and tendinous parts of the Body, giddiness of the Head, and its weakness, and Convulsive motions, spontaneous weariness, and a paralitick distemper, which do all flow from a vitiated nervous Liquor, spoiling the tone of the fibrous Compage of the Brain, and Branches, and plexes of Nerves imparted to the whole Body.

A comparison of Wine with the mass of Blood.

As to the ill constitution of the Blood (productive of the Scurvey) Ingenious Dr. Willis compareth it to Wine, which labourerth of a kind of Sickness, as well as Blood, upon a double account, either as some extraneous ingredient (not easily mixing with the Liquor) is put into it; or when the crasis of the juyce is perverted, because one or more Elements are too much depressed, or others too much exalted.

Extraneous ingredients cast into Wine, resemble the heterogeneous and confused parts of Blood.

As to the first it may be observed in Wine, that where some Grease or Brimstone is cast into it, a great Fermentation ariseth, and unless it be allayed in a short space, the bounty of the Wine will be destroyed; and after the same manner, some heterogeneous Body, running confused with the Blood, doth disturb its regular motion, as a Chyme being crude, or endued with acide or saline Elements associateth with the Blood, and rendreth it highly Fermentative, and obnoxious to variety of diseases.

Wine and Blood are debased when their active and spirituous principles are over-powered by gross Elements.

Wine, as well as Blood, doth first degenerate from its laudable and native disposition, as being debased or corrupted, when its spirituous, and more active principles of Salt and Sulphur are overpowered by other gross Elements; whereupon they cannot extricate themselves, and grow clear and spirituous, but remaining gross, the Wine is endued with an unpleasant Taste, degenerating into a paled Liquor, called *Vappa* in *Latine*. The Blood is somewhat akin to this kind of sick Wine, as its more agile, volatil, saline and sulphureous Particles are depressed by more gross; so that the vital Liquor becometh crude and watry (as in a Dropsy) void of a due Consistence and spirituous parts, which give Life and intestine Motion to the Blood.

Wine and Blood grow di-pirited by too great effervescence by exalted oily Particles.

Secondly, Wine loseth its good temper, as the sulphureous parts growing too exalted, do raise an immoderate effervescence, called Fretting by the Vintners; and not unlike to this the oily parts of the Blood, getting a high Dominion over the Saline, do make a great ebullition in the Heart, productive of a Fever.

Wine and Blood are turned acide, when the Saline parts over-act the Sulphureous.

Thirdly in Wine, the Spirit being evaporated by the ambient heat of the Air, or the sulphureous parts being too much depressed; the Saline over-act the other Elements, and turn Wine into Vinegar; in this a parallel of Wine may be made with Blood, labouring under too active saline parts, which being over-exalted, do obtain a Fluor, and render the Blood acide, found in melancholy distempers.

Fourthly,

Fourthly, Wine loseth its good temper, when its spirituous parts are too much depressed, and the sulphureous and saline Elements (being in combination) are too highly advanced, growing viscid and mucilaginous; whereupon Wines become over-fretted, or ropy, as the Vintners (the Masters of the Art of curing Wines) do phrase it.

Generous Wines upon the Lees in hot weather, have a long and great Fermentation, as the various Elements have great contests with each other, and the spirituous parts do partly evaporate, and are partly confounded with more gross Elements; whereupon the Sulphur being very exuberant, is more and more exalted, and the spirituous part adhering to the saline, doth advance it, and alter the mixtion of the Elements (to which being added, the eminent combination of the Sulphur and Salt) the Wine acquireth a rancide, oleaginous Consistence.

And the Fermentation of the Blood in the Scurvey somewhat resembleth that of Wine, in reference to the former acide disposition, coming from saline Elements, brought to a Fluor, which appeareth plain in acide, saline parts (of Spittle spued out of the oral Glands) with serous Liquor, discharged out of the glandulous coat of the Stomach, by excretory Ducts into its Cavity, and afterward thrown off by Vomiting.

Blood resembleth Wine, as growing acide by the Saline parts brought to a Fluor.

And the Blood also is like over-fretted Wine in its exalted Sulphur, and Salt (as nearly associated) making a rancide clammy quality in the Blood; whereupon it groweth gross, producing a Cough and difficulty of Breathing, and a Leucophlegmatia, as stagnating in the substance of the Muscular parts of the Body.

Wine and Blood are alike, as growing mucilaginous by too great a Fermentation.

Farthermore, the Dyscrasy of the Blood in a Scorbutick habit of Body, is somewhat related to Wine, as it proceedeth from sulphureous-saline Elements, when the Blood is over-powred with Sulphur, entring into confederacy with a less active Salt; whereupon the vital Liquor, acted with an over-fretting motion, doth discharge its adust Recrements by the hepatick Glands, and excretory Vessels, into the *Ductus cholidochus*, and Intestines, and its saline Particles into the Renal Glands, and Urinary Vessels, and Ureters into the Bladder.

And the Sulphureous saline Recrements of the Blood, being of a restless Fermentative disposition, are transmitted out of the Left Ventricle of the Heart, First into arterial Trunks, and then into smaller and smaller Branches, till at last they land in the cutaneous Glands, wherein the adust and saline Recrements (being secerned from the more pure parts of the Purple Liquor) are carried by excretory ducts into the surface of the *Cuticula*, where they are settled or concreted, making Spots, Scabs, Scurfe, Tumors, Ulcers, &c. And if these sulphureous and salt *Feces* of the Blood, be transmitted by the *cæliack* Artery into the Stomach, they produce great pains, Vomitings; and if they be discharged by the mesenterick Arteries into the Intestines, they make Cholick pains, Diarrhæas, Dysenteries, &c.

The exalted sulphureous parts, are the cause of the over-fretting of the Blood.

And if the saline Recrements of the Blood being more predominant, do embody with the concreted oily Particles, the ebullition and fermentation of the vital Liquor is more moderate; and so its rancide, or mucilaginous Particles, make a slow circulation through the *Viscera*, wherein great obstructions are produced, as clammy parts of the Blood do adhere to the sides of the Vessels in their passage, producing a Jaundise in the Liver; and a slow motion of the Blood in the Renal Glands generateth the Stone in the Kidneys, when the Tartar of the Blood, (associated with viscid Recrements) is concreted: and this gross mucilaginous Blood (passing through the substance

The Fermentation is more moderate when the Saline are predominant over the Sulphureous.

The clammy Blood is a cause of the Jaundise in the Liver.

The cause of a difficult Respiration in the Lungs, and of dreadful Symptoms in the Heart.

stance of the Lungs, maketh a difficult Respiration; and this over-fretting viscid Blood taking its progress through the ventricles of the Heart, maketh Palpitations, Lipothymies, Syncopes, irregular Pulsations, and polypose Concretions, which proceed from a gross mass of Blood, which moving slowly, highly oppresseth, and is ready to suffocate the Heart.

The nervous Liquor is very much exalted by the nitrous saline Particles of Air, and advanced by the influences of the Planets.

Having discoursed of the discrasy of the Blood and its Elements in a Scorbutick disaffection; I will take the freedom now to declare, how the ill principles of the Purple juyce do infect the nervous Liquor, which in its own Ingeny is very mild and thin, endued with spirituous, and volatil saline Particles, much improved by the subtle nitrous Particles of Air, advanced with æthereal Atomes, and is exalted by the more benigne influxes of the Sun, Moon, and Stars; whereupon the Animal Spirits having a subtle elastick Nature, do insinuate themselves between the Filaments of nervous Fibrils, (constituting the curious Compage of the Brain) and render them tense and fit for the exercises of the nobler, and more mean operations of Reason and Sense, which they celebrate in great perfection, as long as the Blood is accomplished with fine vital Particles, which being very much impaired in an acide disposition, or when it is debased with gross sulphureous, and saline Recrements, too much depressing the spirituous parts of the Blood; or when it is rendred viscid, and oleaginous, by too much exalted oily Particles, (combining with the saline) putting the Blood into an over-fretting disposition, which vitiath the purity of the nervous Liquor, and taketh off the brightness of the Rays and delicacy of the Temper, relating to the Animal Spirits, (by making them decline toward an acide disposition) whereby they grow depauperated and dispirited, as losing their elastick Nature, and brisk active temper, the cause of many Cephalick Diseases, of Meagrum, Palsies, Tremors, Pains, Convulsive motions, &c. which take their first rise from a discrasy of the Blood, and nervous Liquor, residing in a Scorbutick habit of Body.

The nervous Liquor is depraved by the ill Elements of the Blood, causing many Cephalick Diseases.

The Scurvey is a Parent of many Diseases.

Many Learned Professors of our Faculty have made the Scurvey a kind of *Farrago* of all Diseases, which renders the Art of Physick confused, in a complication of numerous Maladies, having one appellative: This may be truly asserted, that a Scorbutick habit of Body, proceeding from a dyscrasy of Blood, is a Parent of many disaffections, from which almost all Chronick Diseases take their first rise; whereupon in such cases it is proper to mix Antiscorbuticks with other Specifick Medicines, that relate to particular Diseases.

The Antients Opinion concerning the seat and cause of the Scurvey. The Spleen is often found in the Scurvey. An instance of a found Spleen in a person dying of the Scurvey.

As to the Cure of this Malady, the Antients conceiving it to proceed from a melancholy Humor (seated in the Spleen) have directed all their Medicines to the relief of that part; but upon Dissection it hath been found, that Patients (labouring of many symptoms of the Scurvey, as cutaneous Spots, Scurfs, Tumors, Ulcers, wandring pains of the Limbs, spontaneous Weariness, looseness of the Teeth, and bleeding Gums) have had sound Spleens.

I learned *Horstius* giveth an account of this, *Tom. 2. lib. 9. Obs. 4. Ait ille, Nobilis Bavarus annorum 36. Corpulentus, lassitudine spontanea, maculis lividis, nigrescentibus, in ulcera degenerantibus, in cruribus & brachiis affectus, quæ omnia longe ante gingivarum sanguinolentia, & exulceratio præcesserat, ita ut non dubitandum quin scorbuto confirmato laboraret; in quo post mortem lien sat inculpata Constitutionis, viscus sanguinem referens, inventus fuit.*

Some Symptoms of the Scurvey and their Etiology.

Sometimes in this Disease the Stomach, Guts, are oppressed with vomiting of Blood, and Black Stools mixed with it, which proceed from a hot fæculent mass of Blood, of which some part is thrown by the Cæliack Artery, into the

Cavity of the Stomach, and discharged again by Vomiting; and Black Blood is also transmitted by the mesentery Arteries into the Intestines, which disburden themselves by bloody Stools; and other times the Spleen is swelled, and the Liver scirrhus, and the mesentery enlarged by tumefied Glands.

A person of mature age, endued with a melancholy Constitution, as having a Black swarthy visage, often bound in his Body, making a deep coloured Urine (highly tinged with choler) somewhat resembling that of Fevers, was often disturbed with nauseousness, belching, and a pain of his Stomach, and with a bloody Spittle, and Bleeding, ulcered Gums, and sometimes with bloody Stools, and a Tumor of the Groin and Belly; these symptoms were much alleviated by Antiscorbutick Medicines for some time, and then returned again, and were attended with more dreadful accidents of discharging extravasated Black Blood out of the Stomach and Intestines, by Vomiting and Looseness, which gave a period to his Life.

An instance of the said case.

His Belly being opened, the Stomach and Guts appeared to be very much distended with Wind, and being opened, they were found to be lined with Black Blood, spued out of the terminations of Cæliack, and mesenterick Arteries, implanted into the inward coats of the Ventricle and Guts.

The Caule is often inflamed and corrupted, and the Pancreas scirrhus in the Scurvey.

The Liver being Dissected, appeared to be hard and scirrhus, and its substance of a deep Red colour, resembling a fleshy substance; his Spleen was very much tumefied with gross extravasated Blood, and the Mesentery was beset with many tumefied Glands, and the mesaraick Vessels were rendered so obscure by many Glandulous Tumors, that they could be scarce discerned.

The Caule is often rendred, First inflamed, and afterward ulcered and putrid, proceeding from a quantity of extravasated corrupted Blood, settled in the interstices of Vessels; and the Pancreas is sometimes disaffected with many scirrhus Glands, proceeding from a viscid Blood, full of concreted saline Particles.

A Person of Honour some years before his death, was annoyed with a fastide Taft in his Mouth (coming from excoriated Gums, and other Ulcers of his Mouth) and looseness of his Teeth, which were the attendants of ill Viscera, the causes of great sickness determining in death.

His Body being opened, the Caule was found stinking, and putrid, and his Pancreas full of indurated Glands, and the Mesentery deformed with many Black varices of Blood-vessels.

An instance of a corrupted Caule, and scirrhus Pancreas. The seat and cause of the Scurvey.

I conceive the first seat of this Disease is the Stomach, flowing from an ill concoctive Faculty of Aliment, proceeding from ill Ferments of the Stomach, as endued with acide saline Recrements, which infect the Alimentary extract, rendring it sometimes crude, and other times full of earthy saline parts, which being carried with the Chyle into the Mesentery, do render the Glands of the Mesentery swelled; and the gross Chyle being associated with the Blood, and not well assimilated into it, is carried by the Cæliack Artery into the Stomach, and maketh Nauseousness, Belchings, Vomitings, &c. and being transmitted into the Guts, produceth Diarrhæas, Dysenterys, accompanied with great gripes.

The original of the Scurvey being an ill Chyle, proceedeth à *Leſa Concoctione*; whereupon Vomiting and Purging are very proper to disburden the Stomach of the crude reliques of Concoction, and of bilious, and saline Recrements, the ill Ferment of the Stomach, which hinder the concoctive Faculty, and vitiate Aliment: And after the Stomach is discharged of its

The Original of the Scurvey is an ill Chyle.

troublesome guests of saline and Sulphureous Recrements, bitter corroborating Medicines may be advised, which repair the Tone of the Stomach.

The Cure of the Scurvey, (as it is a complication of many Diseases) seemeth to claim a method of healing, satisfying various Indications; but for order and brevity sake, they may be reduced to Three (which are common to those of other diseases) The preservatory, relating to the cause of the Disease; the Curatory which hath regard to the Disease and its Symptoms, and the Vital, which preserves the strength of the Patient.

In the First entrance into the Cure, our great intention must be to take away the cause of the Disease, which being rectified, the Effect, the Disease will fall.

The great cause of the Scurvey is a Discreasy of the Blood.

The cause of the Scurvey, consisting in the ill constitution of Blood, is chiefly founded in the gross sulphureous, and fixed saline Particles, depressing the volatil and spirituous; whereupon the vital Liquor groweth depauperated, as not having good Elements, producing a bad Fermentation, which, that it may be regulated, requires the utmost endeavours of Art, consisting in a good Diet, Chyrurgery, and Pharmacy.

A good Air much contributeth to the Cure of the Scurvey.

In reference to Diet, a good Air must be advised, near a dry ground, free from gross cold vapours, vitiating the pure nitrous, and elastick Particles of Air, which spoil the Blood in the Lungs, and take off much of its fine Scarlet Dy. And the æthereal Particles enobled by the benigne influxes of the Planets, do mixe with the masticated Aliment in the Mouth, and help the concoction of the Stomach, by advancing its Ferments, and by opening the Compage of the Aliment, in order to the extraction of a nutritious Tincture, which much dependeth upon good Food, proper for Concoction, and easy to be distributed, and making few Excrements, of which the more gross must be discharged by the Intestines, and the more saline and watry severed by the Renal Glands, and the Lympha by the Lymphaducts, and the bilious Recrements by the Hepatick Glands; if these Colatories be open, and free from obstructions, the Blood acquireth a laudable Constitution; but if the *Viscera* be clogged with gross Recrements, they cannot duely perform their Office of Percolating the Blood; whereupon it is sometimes depraved with fixed saline, othertimes with gross sulphureous, and also with acide, and acrimonious Recrements, debasing the Blood, and rendring it dispirited: That all these intentions may be satisfied (relating to many disaffections of the *Viscera*, spoiling the eucrasia of the Blood) is our Task at this time, which must be accomplished by a due method of Physick, advising proper Medicines of all sorts in right order.

Good Aliment is one expedient to cure the Scurvey. The Colatories of the Blood must be opened.

The hindred perlocation of the Blood in the *Viscera*.

Purging and Vomiting discharge the Stomack of its ill Recrements.

The First seat of the Scurvey is in the Stomach, and its original cause, is a crude indigested Chyle, often infected with ill Humors, spoiling the Ferments of the Stomach, the great *Menstruum*, dissolving the Compage of the Aliment in order to Concoction; Whereupon it is reasonable to advise Purging and Vomiting Medicines, to free the Ventricle from the importunate guests of offensive Excrements, and to administer bitter Medicines to restore the Ferments of the Stomach to a laudable temper; And if the Pores of the Ventricle be obstructed, aperient Medicines are proper to make way that the Ferments may be transmitted through secret Ducts into the Cavity of the Stomach, to assist Concoction.

Bitter Medicines restore the Ferments of the Stomack to a good disposition.

And in order to reduce the ill mass of Blood (a great cause of the Scurvey) to a laudable constitution, by discharging its Fæces by secretion (performed in the *Viscera*) I conceive it very proper to advise Specificks, to open the obstructed Glands of the Liver, to depurate the Blood from adust bilious Recrements.

Recrements. And in reference to acide, and saline Faces, Diureticks may be prescribed to free the obstructed Glands from concentered Particles, and help the slow excretion of Urine, to refine the Blood from its gross Salt Recrements, which are a great Element in the production of the Scurvey.

Diureticks discharge the Tartar of the Blood.

And because nature often dischargeth the saline Particles (associated with the Blood) by greater and less Arterial Branches) into the cutaneous Glands, wherein a secretion is made of the pure from the impure parts; whereupon they being carried by excretory Vessels to the surface of the Skin, the Blood groweth refined, so that in case of the Scurvey, Diaphoretick Medicines may be prescribed with great advantage to the Patient.

Diaphoreticks are very proper in the Scurvey.

In order to clear the Stomach of its load of acide, saline, and sulphureous Recrements in strong Constitutions, may be given the infusion of *Croeni Metallorum*, *Tartarus Emeticus Mynsichti*, a few grains of *Mercurius vitæ*, Salt of Vitriol; and in weak Bodies, Oxymel of Squills, or a great quantity of *Carduus-Poffet*, or luke-warm water (mixed with Oil of Olives) may be administred, by which the Contents of the Stomach may be thrown off, and the folds of it free from gross, viscid, pituitous Recrements; whereupon the Concoction of Chyle is very much promoted.

Vomitories.

And if the Stomach is weak, or not apt to be moved by Vomitories, gentle purging Medicines are more proper, mixed with bitter (which do corroborate the lost tone of the Stomach in the Scurvey) as the *Decoctum amarum cum purgantibus*, to which in a strong Body, some Senna and Rubarb may be added. The *Tinctura Sacra* may be very proper, made of the *Species Hieræ*, infused in White Wine; as also the *Decoctum Sennæ Gereonis*, to which may be added the tops of Centaury the less, Rubarb, Creme or Salt of Tartar, vitriolated Tartar, the Seeds of *Carduus*, Syrupe of Peach-Flowers, or Syrupe of Rubarb, or compound Syrupe of Apples, formerly called the Syrupe of the King of Sabor.

Gentle Purging Medicines must be given in weak Constitutions. Purging Decoctions are very proper in this Malady.

Pills of Bon, called *Tartaræ Bontii*, *Quercetani*, or those of Dr *Willis* his Dispensation in his 7th Chapter of the Cure of the Scurvey, Pa. 271. As also Stomacick Pills with Gumms, to which may be added in strong Constitutions, some grains of *Extract. Rud.* or *Resine of Jalap.* or Scammony.

Purging Pills.

In plethorick Bodies, abounding with Blood and ill Recrements, after purging Medicines have been once or twice administred, a Vein may be often opened with a sparing hand (lest in this Disease, if too much Blood be exhausted, a Dropsy ensue, which sometimes proves fatal) whereupon the Blood groweth better and more refined.

Bleeding is good in a Plethorick Body labouring of the Scurvey.

And once in Five or Six days Purging Medicines may be prepared by infusion in Water, and Wine, added at last to extract the virtue of the Ingredients) with Senna, Rubarb, Agarick, the tops of Pine, Firr, Water-creffes, Seed of Caroways, Creme of Tartar, &c. to which being strained, may be added Syrupe of Roses solutive, or compound Syrupe of Apples, or Syrupe of Buckthorn.

Purging Medicines mixed with Antiscorbuticks.

Alteratives also may speak a great benefit in this stubborn Malady, made of the aperient roots of Dogs Grass, wild *Asparagus*, *Scorzonera*, mixed with Antiscorbuticks, viz. the tops of Pine and Firre, Watercreffes, Chervil, boiled in Water and Wine, and being strained, may be sweetened with Syrupe of the Five opening Roots; or an Apozeme may be prepared with the Roots of Cuckowpintle, Roots *Petraselen Eryngium*, Winterbark, the chips of Oranges or Limons, Pine, Firre, &c. boiled gently

Alteratives made of Aperients, and Antiscorbuticks.

ly

ly in Water, put into a covered Vessel, to which may be added at last, some White-wine, and it being strained, may be sweetened with the Augustan Syrupe.

An Apozeme
proper in the
Scurvey.

Also a Decoction of *Roman Wormwood*, and tops of Broom, or an infusion of its Buds, or Flowers, made in Water and Wine, and being strained, and sweetened with Syrupe of Betony, or the Five opening Roots, may prove advantageous in opening the obstructions of the *Viscera*, and defacating the Blood.

Infusions of
Anti scorbutick
Medicines.

Infusions of Antiscorbuticks in Water and Wine, (made in a close Pipkin are very proper, as preserving the volatil Salt) of Pine, Firr, Chervil, Ground-Pine, Water-Germander, Garden, or Sea-Scurvey-grass, Watercresses, Brooklime, Chips of Oranges, Limons, Citrons, &c. sweetened with simple Syrupe of Apples, Brooklime, Watercresses, &c.

Infusions of Pine, Firr, Brooklime, and of other temperate Antiscorbuticks, may be prepared in Whey, or Posset-drink, as very good in hot constitutions, to contemperate and refine the Blood.

Diureticks
proper in the
Scurvey.

Diureticks may be beneficial in this Disease (as discharging the saline parts of the Blood by Urine) made of the roots of Cuckowpintle, Horse-Radish, of the Leaves of Garden-Cresses, Chervil, Sowes, prepared in Water and Rhenish-wine.

Antiscorbutick
Juyces.

The juyces of Scurvey-grass, Brooklime, Water-cresses, Chervil, Garden-cresses, Oranges, Wood-sorrel, because the last defacate the Antiscorbutick Liquors, some of which (being depurated *per residendum*) may be taken in Ale, Wine, Posset-drink, or Whey.

Or Expressions may be given with benefit, made of Antiscorbuticks, and of shavings of the Roots of Horse-radish, Cuckow-pintle, of the Leaves of Brooklime, Watercresses, Chervil, Garden-cresses, &c. put into a Pipkin, with White-wine or Rhenish, Canary or Sherry, &c. and after a due infusion, may be strained off, and used.

Antiscorbutick
Syrupes.

Syrupes may be made of the Juyces of Brooklime, Water-cresses, Chervil, Garden-cresses, Oranges depurated *per residendum*, and put into a Glass bottle close stopped, and prepared B. M. with a due quantity of fine Sugar,

Distilled Waters.

Distilled Waters may be prepared with the chips of Oranges, Limons, Winterbark, and with Leaves of Scurvey-grass, Brooklime, Water-cresses, Chervil, tops of Broom, Garden-cresses, Worms, Snails, Sowes, Nutmegs, &c. may be distilled in Milk, Whey, Mumm, Sider (to which may be added some White-wine) in a Rose Still.

A Water may be prepared with Winterbark, the Rind of Tamarisc, the Chips of Oranges and Limons, Roots of Horse-radish, Cuckowpintle, &c.

Antiscorbutick
Spirits.

In Winter (when there are very few Green Herbs) the Leaves of Garden and Sea Scorby-grass, the tops of Broom, Pine, and Firr, the middle Rind of Elder, and Ash, roots of Horse-radish, Winterbark may be distilled in Ale, Whey, Milk, Sider, Mumm, &c.

Spirits made of Scurvey-grass, Water-cresses, Horse-radish, Cuckow-pintle, Hartshorn, Salt Armoniack succinated, may be prepared and given in a few drops, in some convenient Antiscorbutick distilled Water, in Fainting Fits, when the gross Blood is ready to stagnate in the chambers of the Heart; or when it is highly dispirited in this Disease.

Ale or Wine, medicated with chips of Oranges, Limons, and with the Leaves of Water-cresses, Brooklime, Pine, Firr, tops of Broom, Coriander Seeds, Nutmegs, Sowes, &c. may be very advantageous in this Disease.

Or

Or the roots of Docks, Horse-radish, Eryngium, the Leaves of Agrimony, Harts-tongue, Chervil, Garden-creffles, chips of Oranges, Limons, Coriander Seed, Nutmegs (to which may be added the juyces of Oranges, Brooklime, Water-creffles, Garden Scurvey-grass) may be put into new Ale before it hath done working.

Medicated Ale
good in Scur-
vey.

Testaceous Powders are also useful in this Malady, made of Crabs Claws, Crabs Eies, Coral, Pearl, Egg-shells, &c. given in some Antiscorbutick Apozeme.

Testaceous
Powders.

As also Powders prepared with Cuckowpintle, and with the Leaves of Water-Germander, Ground-pine, Wood-lice, Tartar, &c. may be given in some Antiscorbutick distilled water.

Electuaries are proper, made of the Conserve of Water-creffles, Brooklime, Wood-sorrel, Fumitory; to which may be added the Powder of Cuckowpintle, Wood-lice, Salt of Prunell, and Condited root of Eryngium, Pills of Citron, Oranges, or Limons, well pounded in a Mortar, and Condited; and made into the consistence of an Electuary, with the Syrupe of the Five opening Roots, drinking after every Dose of the Electuary, a good draught of an Antiscorbutick Apozeme, or distilled water, mixed with some compound Horse-radish water; Or an Electuary may be made of the Conserve of the Flowers, or Fruit of Sweet-briar, of the Leaves of Fumitory, Wood-sorrel, prepared with the Powders of Coral, Crabs Eies, Crabs Claws, Pearl, and made into the consistence of an Electuary, with the Augustan Syrupe, or that of Fumitory or Water-creffles, drinking after it, as above advised.

Electuaries.

A Water made of Lime with Coriander-seeds, and other ingredients according to the common receipt, may be of great use to open the obstructions of the *Viscera*, and to refine the gross and depraved mass of Blood, in scorbutick dispositions of Body.

Lime-water
good in the
Scurvey.

Chalybeate Medicines, as Powder of Steel, prepared with Sulphur, or Syrupe of Steel prepared with its Salt, or with crude Steel, or the tincture of it, prepared with Tartar, may be given in some proper Antiscorbutick Apozemes, or Distilled water; and once in Four or Five days, a draught of a gentle Purging Diet-drink, or *Pilula tartarea Bontii*, or *Quercetani*, or some proper Purging Powders, or Bolus.

Chalybeate
Preparations.

The purging Mineral Waters of *Epsam*, or *Dulige*, *Barnet*, *Northall*, *Acton*, *Stratham*, &c. As also the Mineral waters of *Turnbridge*, *Rotherfield*, *Wittham*, *Blackboys* near *Lewis*, &c. which purge by Urine, and open the obstructions of the *Viscera*, and defæcate the mass of Blood from its acide, saline, and sulphureous Recrements; the main causes of the Scurvey.

Purging Mi-
neral Waters.

Diuretick Mi-
neral Waters.

In reference to the Stomach, bitter Medicines may be used, prepared with the roots of Gentian, Centaury the less, Wormwood, Salendine the great, Seeds of *Carduus*, Citrons, &c. *Elixir proprietatis* may also be given in the Alexiterial Milk-water, or in Hocumor Rhenish wine, or in any Decoction, made of bitter ingredients.

Bitter Medi-
cines are good
for the Sto-
mach in the
Scurvey.

Fomentations made with Centaury the less, Wormwood, Berries of Bays, Juniper, Seeds of Flax, Fenugreek, the Flowers of Chamæmel, Melilote boiled in Water, (to which at last Wine or Brandy may be added) do corroborate the Stomach, and discharge flatulent Matter, lodged in the Stomach and Guts.

Fomentati-
ons for the
Stomach.

In reference to the obstructions of the Liver, Turmerick, Salendine the great, the Rind of Berberies, the Leaves of Agrimony, Harts-tongue, shavings of Ivory may be boiled in water, adding some Wine at last, and it being strained, may be sweetened with Syrupe of the Five opening Roots,

Hepatick Me-
dicines in ob-
structions of
the Liver.

Medicines
proper for an
Astma, com-
plicated with
the Scurvey.

In point of a difficult Breathing, Pectorals may be administred, prepared with the Leaves of Dogs-grass, *Asparagus*, and the Leaves of Ground-Ivy, Hyssop, Pine, Firr, Wood-lice, &c. boiled in Water and Wine, and sweetened with Syrupe of Ground-Ivy; as also a *Linctus* may be made of *Oxymel simplex*, *Scibliticum*, Syrupe of Horehound, Vinegar, mixed with Powder of Wood-lice, Liquorice, and made into a Lambitive, with the Syrupe of Maydenhair.

And above all, in a Scorbutick *Astma*, flowing from abundance of Blood, accompanied with Phlegmatick, or gross saline and sulphureous Recrements, Purgatives and Bleeding may be advised.

Cephalick
Medicines,
mixed with
Antiscorbu-
ticks, are pro-
per in the
Scurvey.
Gargarismes
are proper in
Diseases of the
Mouth.

In Cephalick Diseases (complicated with Scorbutick disaffections) flowing from acide, saline, and sulphureous Elements (tainting the nervous Liquor) Cephalicks, mixed with Antiscorbuticks, are very proper, which do refine the Blood and Animal Liquor, and reduce its Spirits to a laudable Constitution, and corroborate the laxe Tone of the fibrous Compage, relating to the Brain.

In disaffections of the Mouth, Gums (laxity of the Teeth) abounding with serous and saline Particles of Blood, the Gums may be opened with a Lancet, and Gargarismes administred, made of Leaves of Woodbine, Columbine, Speedwel, Water-creffes, Scorby-grass, the inward Rind of Elm or Elder, boiled in Lime-water, or Fountain-water, to which some White-wine may be added at last, and it being strained, may be sweetened with Honey of Red Roses, and Syrupe of Mulberies.

A Diet-drink
good for the
pains in the
Limbs.

In the pains of the Limbs, Decoctions of Sarza, mixed with Antiscorbuticks may be given with good success; As also a Decoction of Sarza in Water, and being strained, may be mixed with Milk, and taken with great benefit.

Fomentati-
ons.

Fomentations in this case made of Anodynes, Discutients, mixed with Antiscorbuticks, will appease the pain of the Limbs, being outwardly applied with Flannel.

C H A P. LXXVIII.

Of Osteology.

THe Body of Man being a fine Building, is composed of more fluid and solid Materials, the first being the Superstructure, and the last the Foundation, which giveth figure, straightness, and strength to this magnificent Pile of Building, which is compleated by the *Viscera*, as so many Laboratories and Colatories of Liquors, and immured within common Integuments of Membranes and Muscular parts, as so many Engines, affixed to variety of Bones, the Centers of Motion, and the Bases of the parts of the Body; which else would be confused and useless, were they not encompassed with, and kept apart by numerous Bones as so many Preservatives and Intersepiments, guarding and severing one part from another, that every Member and Bowel may freely exert their Operations, without the least discomposure or violation of each other; So that some delicate Contextures of Parts being so many fine Vails, do face this more solid Compag, and others are immured within their hard Confines, as secured within the safe Walls of a strong Castle.

The Bones are called by the *Greeks*, *ὀστέα*, as keeping the Fabrick of the Body in an erect posture, as *Hipocrates* hath most elegantly expressed it, *lib. De Ossium Natura*, *τὰ ὀστέα πρὸς στήθεσιν ἑστάν, καὶ ὀρθώματα, καὶ ἐκείνη παρέχοντι. toti corpori stabilitatem, & rectitudinem, & formam exhibent.* Whereupon Bones may admit this Description, as being hard similar parts, and most cold and dry and destitute of Sense, giving strength and support to the whole Fabrick of Man's Body, which is a system of many parts, of which the Ambient are divers Coverings; the most fine is the *Cuticula*, conjoined to the *Cutis*, a Compag of many Fibrils, united to the Adipose Membrane, and this to the Common Membrane of the Muscles, which are fastned to each other by the interposition of many small Ligaments, and at last, as to a common *fulcrum*, all these Integuments, as well as the Muscles of the middle Apartment of the Back, and the Pectora, and Saw-like, and Intercoastal Muscles, are affixed behind to the Chine, and on the sides to the Ribs, and before to the Sternon.

The outward Coverings of the Head consisting of Hair, the *Cuticula*, *Cutis*, *Membrana Carnosa*, and *Periostium*, is conjoined to the Skull without; and the more inward Coverings of the *Dura* and *Pia Menynx* the fine Vails of the Brain are united to it by the mediation of Vessels and Fibrils, and also to each other as well as to the Skull, guarding the tender Compag of the inward parts of the highest Apartment, as with a natural Helmet.

The common Vests of the lowest Apartment, and the various Abdominal Muscles, are supported by Bones, to which they are fastned as Bases, or Centers of Motion, the universal Coverings are tied to the Abdominal Muscles (by the interposition of Fibrils) and these again either in their Originations, or Insertions, are conjoined to Bones, as so many *Hypomoclia*.

The oblique descendent Muscles take their rise from the four or five lower Ribs, and are implanted into the Margent of the *Os Ilium*.

The Body of Man of is made of fluid and solid parts

Bones are the Centers of Motion and supporters of the Body.

The Description of Bones.

The Muscles are conjoined to Bones as so many Hypomoclia.

The

The oblique Ascendent Muscles take their Origen near the Bone where the other do terminate, and are inserted into the inside of the lowest Rib.

The transverse Muscles are fastned to the Spine, *Os Ilium*, and lowest Rib, and the right Muscles above to the Sword-like Cartilage, and below to the Share-bone.

The Rim of the Belly (to which the Caul is conjoyned by many Ligaments) is affixed below to the *Os Ilium* and Share-bone, and the Liver, Spleen, Kidneys, and Intestines are fastned to the inside of the Chine, by the mediation of great Trunks of Arteries, and Veins.

The *Viscera* of the middle Apartment are also conjoyned to Bones, as their great *Fulcrum*.

The Midriff is connected to the Ribs, and the Heart, and Lungs, in their Origens to the inside of the Spine by the interposition of the *Vena Cava*, and *Arteria Magna*; And the common Coats of the Limbs are affixed by Ligaments to each other, and to the Muscles, which are implanted into various Bones, as the Centers of Motion; so that the bony Compage is highly significant to the Body as it hath it's various parts, either immediately or ultimately affixed to Bones, giving stability, straightness, and form to the whole Body.

The origination of Bones.

The Bones in their first entity, *in solutis principiis*, are a fluid Body, and borrow their origination from the Tartar of the Genital Liquor, as consisting of most earthy, and some saline Particles, which do coagulate the gross viscid parts of the Seminal Juice, first into a membranous substance, as near akin to a soft liquid body, and afterward by the accession of new earthy saline Particles, passing through the termination of the Arteries (implanted into a membranous substance, the rudiments of Bones) whereby the more soft Matter is turned into a grissly body; and at last by a source of new Tartar, flowing out of the Extremities of the Blood-vessels, the Cartilaginous substance arriveth a greater maturity, and by degrees is concreted into perfect Bone.

Bones are framed of various parts.

Bones are framed of heterogeneous parts, of which the outward are more solid and white, being adorned with a hard smooth Surface, as if it were polished by Art, and its more hard Particles are made up of many thin *Laminae*, (as I most humbly conceive) which are produced by many saline accretions one succeeding another, according to the new accession of Matter, turned into Bone.

The Cells of Bones are receptive of oily Particles commonly called Marrow.

The more inward recesses of Bone are more spongy and black, often attended with many little Cells of various figures and sizes, receptive of fat Particles, which are the product of the oily parts of the Blood (destilling out of the terminations of the Arteries) concreted into a Medullary substance, (which is also lodged in large round Cavities of large Bones) encircled with a thin Membrane.

Marrow proceeds from the oily Particles of Blood concreted.

And farthermore, I humbly conceive, that the unctuous liquor of Marrow is entertained into divers Cavities (encompassed with thin Membranes) wherein the oily parts of the Vital Liquor are confined, and coagulated into Marrow, which is endued with a sweet taste, and an inflammable nature.

The use of Marrow.

Learned *Diemerbroeck* is of an opinion, that this Medullary Matter keepeth the Bones from being liable to be broken (as supplying them with its fatty substance) whereupon they being affected with an emollient quality, have their dimensions in a capacity to be enlarged, till the Bones have acquired their maturity in a due magnitude. *Ait vir eximi-*

cus, lib. nono de Ossibus Cap. I. Pag. 877. Hac pinguis medulla, ossibus maxime necessaria fuit, quippe tartarea particula, cum fixationi proxime sint, in glaciale duritiem citissime concreverent, sicq; ossa maxime fragilia fierent & ad justam magnitudinem non pervenirent, nisi illa Medullosa pinguedo, tota ossa pervadens tartarearum particularum summam duritiem nonnihil impediret, & emolliret, atq; sic efficeret, ut in corporis incremento minimæ istæ tartarea particula à seinvicem recedere, novæq; intermisceri, sicq; ossa increfcere possent; quod incrementum tandem desinit, cum à totius corporis increfcente calore ita exsiccantur istæ particulae, ut à Medullosa pinguedine (quærit ipsa increfcente ætate ac calore, crassior minusq; humida evadit) amplius emolliri & à seinvicem diduci nequeant. Whereupon it happens, the more exalted the heat of the Body is rendered in mature age, the less the Body groweth in length, by reason the Bones which are the foundation (upon which the structure of the Body depends) are more and more indurated, and the Marrow becomes more thick, and less moist; whereupon it happens, that Infants grow much in a short time, and Boys and young Men still less, and old Men not at all; because the Marrow is slowly generated in mature and old Age, and from hence the Bones are very obnoxious to Fractures, which is occasioned by their great driness and hardness, and do not easily coalesce, by reason of the slow production of *Callus*.

Bones are furnished with many small Arteries and Veins which enter into the very substance of the Bones, and import and export Blood to and fro their Penetrals, else how can they participate heat, life, and nourishment, which is performed by the grosser, and more terrene and saline parts of Vital Liquor, secerned from its more pure Particles, and returned by smaller Ramulets toward the greater and less Trunks of Veins toward the Heart; So that the earthy and saline parts of the Blood (being secerned from the more refined Particles) as near akin to the substance of Bones, are easily assimilated into it.

Bones are accommodated with Arteries and Veins.

And if the Courteous Reader be dissatisfied, as conceiving it not obvious to Sense, by reason the Blood-vessels cannot be any where discerned by the most curious Eye assisted by Art, to enter into the Compag of the Bones, which is caused by the minute Branches of Vessels, first entring into the *Periostium*, and afterward creep into the most small *Foramina* of the Bones; So that if we denude the Bones of its *Periostium* in order to discover the Vessels, they being very minute, are easily lacerated, and seem to be round Ligaments, fastning the *Periostium* to the Bone, whereas there are also Blood-vessels insinuating themselves through the *Periostium* into the Pores of the Bones, and imparting Vital Liquor into their most inward Recesses; So that the Cavities are manifest in the great Bones of the Shoulder and Thigh, endued with Arteries wherein Blood is transmitted into the *Medulla*, tinging its Surface with a reddish Colour, and their entrance may be seen into the *Meditullium*, the fungous parts of the Skull (seated between the two Tables) and in the spongy parts of the Ribs and other Bones of Infants which are bedewed with Vital Liquor, imported into their loose Compag by Arterial Channels, which are afterward implanted into their Membrane and substance of the *Medulla*, out of which the superfluous Blood is carried back again by Veins, penetrating the substance of the Bones, and afterward passeth from greater Branches and Trunks till it arrive the Heart.

Vessels may enter into the small *Foramina* of Bones.

Blood is transmitted by Arteries into the substance of Bones and their Medullary part, and returned again by Veins.

And this Hypothesis is very consonant to Reason, that the Arteries should be carried by secret passages through the more solid and fungous parts of Bones into the Marrow, else how can they be receptive of life and nourishment, unless they be supported by Vital Liquor, conveyed by Arterial Ducts, into the substance of Bones and Marrow, wherein the Blood (not spent in the maintenance of Life and Nutrition of the said parts) is returned by the Extremities of Veins, the necessary associates of Arteries, into all parts of the Body.

The Alimentary Liquor of Bones.

The manner how Marrow is nourished.

The Foramina of great Bones are very conspicuous.

So that the *Succus Nutricius* of Bones are the more gross, and earthy parts, mixed with fixed, saline Atomes (which being carried with the Vital Liquor through secret Pores by Arterial Ducts into the substance of the Bones) are severed from the more refined Particles, and concreted and united to the Compage of the Bones; And these earthy and saline parts, confederated with the Blood, are not only transmitted into the inward recesses of the Bones, but the gross oily parts pass quite through them as conveyed by Arteries into the Membrane (encompassing the Marrow) wherein the unctuous Atomes of the Vital Juice being secerned from its purer parts into the Interstices of the Vessels, are thence transmitted through most minute passages of the Coat into the body of the Marrow, where it is assimilated into its oily substance; But it may be the Curious Reader is not satisfied how Blood can be conveyed into the Medullary substance of the Bones, seeing their Pores are so minute, that they cannot be discerned, which must be understood only of small Bones, and not of great, in which the *Foramina* (letting in the Blood-vessels) may be discovered by a Curious Eye, and the Marrow (lodged within the Bones of a young dead Child newly born) may be seen upon a Fracture to be bedewed with Blood, tinging the Coat, and Medullary substance within it.

Learned *Bartholine* is of an opinion that the gross, earthy, and saline parts of the Blood, are the remote Matter of Nutrition in Bones flowing from thence into the Marrowy substance, wherein it receiveth a farther Elaboration.

Nutrition is a continued Generation.

And this Renowned Author is guided in his opinion by the Oracles of our Art, *Hoc docuit Galenus Capite ultimo, Libro 3^o de Facultatibus naturalibus. Qualis, inquit, est Carnibus sanguis, talis est ossibus Medulla. Et ante eum, Hipocrates libello de alimento, apertis verbis id pronunciauit, μέντοι τῶν ὀστέων, Medulla est alimentum ossis.* But with deference to these Great Authors, this reply may be made; *Quod iisdem nutrimur, ex quibus nascimur*, by reason (as I humbly conceive) that Nutrition is a kind of continued Generation, whereupon some parts of the Blood are near akin to those of the Genital Liquor, whose more earthy and saline parts are the Matter of Bones in their first production, and the gross fixed parts of the Blood (and not the oily, which are Medullary) are the *Materia substrata* of their Nutrition; So that it is very conspicuous to Sense and Reason, that the broken Bones do coalesce and consolidate, not by the Medullary substance (lodged in the Cells and greater Cavities of Bones) but by a Callous Matter (uniting the broken Bones) proceeding from the Tartar of the Blood, which is first fluid, and afterward concreted into a solid substance, by which the Extrems of the broken Bones are firmly conjoined.

And

And it may be farther urged in the favour of this Hypothesis, that the nutrition of Bones is accomplished by some parts of the Blood, by reason when the Alimentary part is very superfluous, Nature cannot dispose of it by turning it into a bony substance, nor transmit it into the Extremities of the Veins, whereupon the gross parts of the Blood, being stagnated in the substance of the Bones, do render them soft and carious, which produceth a kind of abscess, and putrefaction of the Bones.

The nutrition of Bones is performed by Blood.

And if the Reader remain yet unsatisfied that Blood-vessels do not penetrate the close and hard Compage of Bones, whereupon Blood cannot be transmitted by the termination of Arteries into the body of Bones to give them life, heat, and nourishment, to which this reply may be made, That by Autopsy in a carious Bone, the Artery may be plainly seen to make good its pulsation; And this hath been confirmed by an Observation of Learned Spigellius, Plempius having been present. *Huc accedat Spigellii observatio, qui Patavii in ossis tibiae magna Carie substantiam ossis ab Arteriola pertusam vidit, cui spectaculo se affuisse refert Plempius;* This Assertion also of the Arteries perforating the Compage of Bones, may be backed by Renowned Diemerbroeck's Observation, *Lib. IX. de Ossibus Cap. I. Pag. 878. Ait ille, Mense Septembri, Anni 1663. una cum Chirurgo tractavi adolescentem, cui tibiae os anteriore parte circa medium, ubi durissimum est, carie admodum erosum erat: Ablata tota incumbente carne, cum periostio vidimus in cavitate interiore, quæ usq; ad Medullam non perveniebat, Arteriolam satis fortiter pulsantem, cum tamen eo durissimo ossis loco nemo unquam Arteriam invenire potuit.*

The entrance of the Arteries may be seen in carious Bones.

The Compage of Bones is made up of a double substance; the Ambient parts (especially in the middle between the Protuberancies) are more firm, hard, and solid, as also white and smooth, as if they were Glased and Polished, but the inward recesses of Bones are more soft and spongy (chiefly in their Prominencies and Extremities) beset with numerous Cavities of different shapes and sizes, receptive of an oily Medullary substance, softning the inward Compage of Bones.

Bones are made of a double substance.

The great round Bones of the Thigh, Leg, and Arms, are endued with large Cavities to render them more light, lest they should give great trouble to Animals in progressive motion, by reason of their weight; And as Galen will have it, Nature hath made them hollow to entertain Aliment in their greater and lesser Cells, as in so many Repositories. *Τὰ κοιλὰ δ' (Inquit ille) lib. 2. περὶ χρείας Cap. 18. ἐκ ἐμμελεν ἀπορροῦν καὶ ἀναρῶν καὶ ἢ πρὸς τὰ ἀπορροῦν τε καὶ ἀναρῶν αὐτοῖς ἐναποθεῖναι, Cavitates autem has natura non reliquit inanes, cum ipsa penum quandam alimenti familiaris in ipsis possit reponere;* and the Bones are also made hollow, that they might transmit Vessels of divers kinds, Arteries, Veins, and Nerves, and that the Chine might entertain and secure the Spinal Marrow.

Great Bones are endued with large Cavities to render them light.

Most Bones are furnished with a kind of Medullary substance, sometimes hued with a reddish or yellowish colour, which is found in the greater Cavities of Bones, and in the smaller, it seemeth to be endued with a more white Colour, and of a more thin consistence.

Some Authors have imagined Lions and Estriges to have all their Bones destitute of Marrow, and the reason of their mistake, was the smallness of the Cavities relating to their Bones; but upon a more curious Inspection, their Bones have been discovered to have their

small

small hollownesſes as ſo many Cells, furniſhed with an Oily, Marrowy ſubſtance.

The body of the Bone is accommodated with two Extremities, called *ἄποφυς*, and *ἐπιφυς*.

A Bone ſeemeth to be conſtituted of three parts, the Body ſeated in the middle, and the other two may be called Extremities (growing to the body of the Bone) called by the *Greeks* *ἄποφυς*, and *ἐπιφυς*. In a *Fetus* they ſeem both to be *Epiphyſes*, and afterward in more mature age they become *Apophyſes*, and firſt they are endued with a membranous, and afterward with a cartilaginous, and laſtly are turned into a bony ſubſtance, as their accompliſhment and perfection.

The Origin and deſcription of *Apophyſis*.

Apophyſis is ſo called *ἀπὸ τοῦ ἀποφύεσθαι*, *Ab oriri*, as taking its riſe from the body of the Bone, and is nothing elſe but a proceſs or more protuberant part, coming out of the body of the Bone, as a Branch ſprouteth out of the Trunk of a Tree.

A Proceſs hath three Names from diverſity of Figures.

A Proceſs is dreſſed with a threefold Figure, the firſt is round, called by the *Greeks* *κεφαλή*, if it be large, and if the Proceſs be adorned with a leſs and more flat ſhape, is called *κόνδυλος*.

If the *ἄποφυς* be long, ſometimes it terminates into a Cone, and is called *κοράνη*, ſomewhat reſembling the Bill of a Crow, as the Anatomists will have it.

And if the oblong Proceſs do terminate into a part of ſomewhat more large dimensions, it is called a Head as it were affixed to a Neck.

A deep *Apophyſis* is called *Acetabulum*.

A hollow *Apophyſis* is either deep, or ſuperficial; the firſt is called *κοτύλη* *Acetabulum*, and is compoſed of a double Proceſs in the *Iſchium*.

A Superficial Cavity in the *Apophyſis*, is called *γλήνη*.

The ſuperficial hollow Proceſs is ſtyled by the *Greeks* *γλήνη*, ſiſve *γληνοειδής*, *ab Ocularis ſinus ſimilitudine*, and is engraven in one *Apophyſis* in the *Scapula*.

The Figure of a *Sinus* is very various.

The *Sinus* is very different in reference to its Figure, round in the *Scapula*, oblique in the Vertebrae, and double in the Extremitie of one Bone, becauſe it receiveth two Protuberancies of another Bone, as in the Bones of the Leg and Fingers, and reſembleth the Letter C in the Cavity of the *Ulna*, into which the Bone of the Shoulder is received. And the Circumferences of a hollow Proceſs have divers Appellatives, among the *Greeks* *χείλη*, *ἀμβώνας*, *ὄφρυες*, *ἵψες*, *Labra*, *Umbones*, *Supercilia*, *Oræ*.

Labra are Circular *Sinus*.

Labra are ſo ſtyled, when Proceſſes being very prominent, and the *Sinus* are engraven after a Circular manner, moſt eminent in deep *Sinus*, although theſe are found in all Articulations, and Commiſſures of Bones, yet are moſt conſpicuous in deep Cavities: Whereupon in the *Sinus* of the *Coxendix*, into which the head of the Thigh-bone is received, the *Supercilia* are moſt deep and prominent, that the *Sinus* being more hollowed, might hinder the Luxation of the Thigh-bone.

Supercilia are deep in great Articulations.

The uſe of the Proceſſes of Bones.

The prime uſe of the Proceſſes of Bones may be for the more convenient Articulation and Commiſſure of Bones; as alſo they are ſubſervient to the Origins and Inſertions of Muſcles and other parts.

The moſt hard and ſolid Compag of Man's Body, called by the *Greeks* *σκέλετος*, is not one entire ſubſtance, but a ſyſtem of many Bones finely ſet together in many Joynts, made for various motions of the Limbs, and Trunk, wiſely contrived by Nature for many uſes, one of which, and a prime one too, is Progreſſive Motion, which is very conducive to health, pleaſure, and converſe of our Friends, as well as the conduct of our neceſſary affairs.

Bones are conjoyned by the benefit of Articulation, when one Bone is brought near another by Contiguity, or when two Bones are made one by a natural union; As *Galen* hath it in his Book *De Ossibus*;

Ait ille, ὅτι ὁ τελεπῶν τὴ συνδέσει αὐτῶν δὲ τὸς καὶ γένος, ὁ μὲν ἔτερος καὶ ἀθροῦν, ὁ δὲ ἕτερος καὶ σύμ-
φυσιν. *Modus, quo ossa componantur, duplex est, alia per articulum, alia per unionem junguntur*; Which he explaineth in another place of the said Book, τὸ μὲν ἀρθρον ὅτι σύνταξις ὁσῶν φυσικῇ ἢ δὲ σύμφυσις ἕνωσις ὁσῶν φυσικῇ. *Articulus est naturalis ossium Compositio; symphysis naturalis unio.*

A double conjunction of Bones, one by Articulation, and the other by union.

And the Joynts in manner of Articulation are rendred different, by reason of variety of Motion, according to the Great Author; Διαφορὰν τῶ μὲν ἀρθρου δύο εἶσι, διαλάττουσι ὅτι καὶ κινήσει πόσῳ. *Differentia articuli duæ; differunt autem pro motus quantitate.*

One kind of Articulation is called by the *Greeks* ἀρθρωσις, and another is styled by them ἀνάρθρωσις.

The first kind hath, by reason of its loose Articulation, a more manifest motion, ἀρθρωσις ὁσῶν ὅτι σύνταξις ἐναργὴ πῶς πρὸς ἀλλήλα κίνεσιν ἐχόντων, *Compositio manifestum motum habens*, and hath three kinds.

Two kinds of Articulation in point of motion, the first kind of Articulation, ἀρθρωσις is loose, and hath 3 kinds; The first is ἐνάρθρωσις, wherein the head of one Bone is received into the deep Cavity of another.

The first is called ἐνάρθρωσις, wherein the head of the Bone, protuberant out of a long Neck, is received into a deep Cavity; in this Articulation, the head of one Bone is inserted into one eminent Cavity, as it is in the conjunction of the *Coxendix* with the *Ischium*, and of the *Humerus* with the *Scapula*, and in the Bones of the Head and Foot with the first Bones of the Digits.

This kind of Articulation is accommodated with various motions, celebrated in different Joynts, the Thigh and Arms are endowed with Flexion and Extension, and may be drawn inward and outward, and seem to make a kind of Rotation, but in truth are various successive motions made upward and downward, inward and outward, which do not amount to a true Circumrotation, which is one entire circular motion, not constituted of various successive motions, which are only found in the Arm and Thigh.

The second kind of Inarticulation (is called ἀρθρωδία) wherein the small head of one Bone (being only a little Protuberant, as depressed) is received into a shallow Cavity of another, as if the contiguous Bones were conjoyned, as it were in a Plane; whereupon it is difficult to distinguish the head of one Bone from the *Sinus* of the other, which kind of Joynt admits only a very obscure motion scarce discernible, which appertains to the three inward Bones of the *Tarsus*, contiguous to the Bone resembling a Boat, and to the Bones of the Feet conjoyning to the Bones of the *Tarsus*, and to the Clavicle united to the upper Process of the *Scapula*.

The second kind of Articulation is called ἀρθρωδία, in which the head of one Bone is received into a shallow *Sinus* of another.

The third kind of Inarticulation hath the name of γίγλυμος, which consists in manifest Heads and *Sinus*, not made of one uniform Surface, whether Concave, or Convex, or Plane; for this Inarticulation is so constituted (wherein there is a mutual ingress of contiguous Bones) that the Convex Surface of one Bone insinuates into the Concave of the other, after the manner of Hinges of Doors and Windows (from whence this kind of Inarticulation receives its denomination) whose Joynts are made by the riving

The third kind of Articulation named γίγλυμος, wherein is mutual Ingress of different Bones.

The reason of the denomination of this Articulation.

ting of one Plate within another, as the Convex Surface of one is insinuated into the Cavity of the other; After this manner the second and third Bone of the four Digits of the Hands and Feet are inarticulated, and so is made the Inarticulation of the Thigh-bone with the Bone of the Leg, wherein one Bone hath two Heads inserted into one *Sinus* of the contiguous Bone, and the other Bone hath two *Sinus*, parted in the middle by one Protuberance; so that the two heads of one Bone, do make their ingress into the two *Sinus* of the other, and the *Sinus* of the one receiveth the head of the other.

And not different from this, is the Conjunction of the *Ulna* with the *Humerus*, where the Orbicular head of the *Ulna* is inserted into the *Sinus* of the *Humerus*, and Nature in this kind much consults the strength of the Joynt to prevent a Luxation in violent motions, by reason not only two Bones do meet in one Joynt, but two or three distant Bones do assist each other in a mutual conjunction, as in the middle of the *Cubitus*, in point of length, lest the *Radius* should be unnaturally severed from the *Ulna*, Nature hath conjoyned the *Radius* to the *Ulna* with a double Joynt; So that the Head of the *Radius* in one part entreth into the *Sinus* of the *Ulna* about the bending of the *Cubitus*, and below near the Wrist, some little part or head of the *Radius* is inserted into a small *Sinus* of the *Ulna*; whereupon the *Radius* by the help of both these conjunctions, is turned about, and now acquireth a prone position, and then a supine.

The Bone of the *Occiput* is fastned to the first Verteber by a double Articulation.

Farthermore, In order to the passage of the *Medulla Spinalis*, the Bone of the *Occiput* is tied to the first Verteber with a double Inarticulation, and by reason of their help the Head is moved forward and backward, and Nature hath wisely instituted a double Joynt, to prevent a Luxation in the first Verteber, which might easily have been occasioned in a violent motion by the great weight of the Head, had not the Bone of the *Occiput* been conjoyned to the first Spondyle of the Neck by a double Commissure.

The first Verteber is tied to the sides of second, with a double *Arthrodia*.

Moreover the first Verteber is conjoyned to the sides of the second with a double *Arthrodia*, and the dentiform Process of the second Verteber, is after a manner Inarticulated with the first; So that with the benefit of those three Articulations the first Verteber with the Head, maketh no perfect Circumrotation (as being hindred by the dentiform Process) but only is drawn toward the right and left Shoulder in successive motions, both which make but a segment of a Circle.

In the eleven first Vertebres, the inferior Veteber of the *Thorax* hath its ascending Processes by an *Arthrodia* conjoyned to the descending Processes of the superior Spondyle.

And by reason all Vertebres of the Chine being many (are perforated as Repositories of the *Medulla Spinalis*) Nature hath not only used simple conjunctions, but made a peculiar Inarticulation, which is not loose but close and firm, in the Second Verteber to the Twelfth, wherein the inferior Verteber hath its ascending Processes conjoyned according to an *Arthrodia*, or close Inarticulation to the descending Processes of the superior Spondyle; And these Vertebres are acted not with Flexion forward and Tension backward, but with a lateral motion, as the weight of the Body leaneth sometimes more on one side, and sometimes on the other.

The Twelfth Verteber of the *Thorax* and every Verteber of the Loins hath a loose Articulation.

The Twelfth Verbeter of the *Thorax*, and every Spondyle of the Lines with its descending Processes, is conjoyned with a more loose Inarticulation (which is called *Enarthrosis*) to the ascending Processes of the inferior Verteber.

An Antient Learned Anatomist, referreth the Inarticulation of the Vertebrae of the Chine a *Gynglymon*, whereas all, except the First and the Twelfth, have a *Sinus* in one extremity, and a Protuberance in the other, whereby they mutually receive, and are received, which can no way be accounted a *Gynglymus*, to whose constitution three Bones are required; First of all, that a Bone may be received into the superior region; Secondly, That another may receive this Region; Thirdly, That the lower part of the first Bone may be entertained.

Most of the Vertebrae are not Inarticulated per *Gynglymon*.

Bones are closely conjoyned to each other, *καὶ συνάρθρωσις*, (from whence ensueth an obscure or no motion) which hath three kinds, the first may be called *εὐσφῆ*, *sutura*, which alludeth *Consutis*, and if it be a true Suture, it somewhat resembleth Teeth which receive each other in mutual embraces, as they are insinuated into one anothers Interstices, that the Bones of the *Cranium* may be firmly conjoyned by the interposition of numerous Teeth.

Συνάρθρωσις is a close Articulation of Bones, the first kind is called *εὐσφῆ*.

Ἀρμυρία is a composition of Bones (made by a mere Line) conjoyned without a mutual ingress of a Protuberance or Asperity into any *Sinus* or Cavity, after this manner some Bones of the upper Mandible, and chiefly of the Nose seem to be conjoyned. But by reason most of the connexions of Bones (made by a conceived *Ἀρμυρία*) are exactly accomplished by a simple Line, but some little roughnesses do enter into some Superficial *Sinus*, these conjunctions of Bones may be rather called *Sutures* than *Harmonia*.

Ἀρμυρία is a union of Bones in a mere Line.

Γόμφωσις, *sen Conclavatio*, is wherein Bones are fastned after the manner of a Key into a Lock, as it is conceived by Anatomists; this Inarticulation is peculiar to Teeth, and is a composition, wherein the Teeth are lodged in Cavities of the upper and lower Mandible as in proper Cells, and are also fastned to the Gums by Ligaments, and about their bottoms by Bloodvessels and Nerves.

Γόμφωσις is a kind of Articulation of Bones after manner of a Key.

Σύμφωσις is a natural union of Bones, wherein their Appendices, are closely conjoyned after the manner of a Commissure; in *Embryos* (wherein the substance of Bones is either membranous in their first rudiment, and afterward Cartilaginous and spongy) in which they are united by a soft interposition, but when their Cartilaginous nature groweth bony, their Appendices are united so closely without the mediation of any membranous or Cartilaginous substance, that a Line cannot be discerned; After this manner the Bones conjoyned to the sides of the *Os Sacrum*, do coalesce in the Share-bone. In Children the Bone of each side, doth seem to be formed of three Bones, which are distinguished by three Lines adjoyning to the *Os Coxendicis*, which is very conspicuous in Lambs, in which a Cartilaginous substance passeth between these Lines, as in Children; and when they come to greater maturity, these three parts of the Bone grow so close together, that no shadow of any Lines can be discovered, as the Bone of the *Occiput* and Vertebrae, which are composed of many parts in *Embryos*, which afterwards are so nearly conjoyned, that they make one entire long substance, without the least appearance of any Line or Commissure where they are united.

Σύμφωσις is a natural union of Bones.

Articulations of Bones which are not made *per symphyisin*, are conjoyned by the interposition of some other heterogenous medium, when they unite by a Ligament it is called by the Antients *συννέφωσις*, by reason they conceived Ligaments to be Nerves. All Joynts have their Bones conjoyned to each other by Ligaments, either encircling them (as it is found in most

The Articulation is called *συννέφωσις* when Bones are united by a Ligament usually called a Nerve.

Inartia

συνσπλκωσις
is a union of
Bones by the
mediation of
Flesh.

Inarticulations) or by Ligaments arising out of the middle of the *Sinus* and head of the Bone, which is very conspicuous in the connexion of the Thigh-bone with the *Os Ischium*.

Many Bones are mutually fastned by the interposition of Flesh, which is manifest in Muscles encompassing the Joynts, by reason Muscles take their origins from one Bone, and are inserted into another, may claim unto themselves the title of Bonds, as they tie one Bone to another, and by reason Muscles were styled Flesh by *Aristotle* and his Followers; this conjunction of the Bones was called *συνσπλκωσις*; and after this manner the Teeth are fastned to the Gums.

συνσύνδρυσσις
is a union of
Bones by the
interposition
of a Carti-
lage.

Farthermore, some Bones are united by the mediation of a Cartilage, (called *συνσύνδρυσσις*) which is found in *Embryos*, before their Bones attain unto perfection, which being effected, the conjunction of Bones is made *aut per harmoniam, aut per symphysin*, wherein the Bones are united without the appearance of any Line or Seam.

CHAP

C H A P. LXXIX.

Of Bones of the upper Jawe.

HAVING given an account of the nature and origen of Bones, and of many of their Inarticulations, and of some Bones in particular, set forth in a former discourse of the *Coxyx*, *Os Sacrum*, Vertebres of the Loins, Back, Neck, and of the *Cranium*, and most of its Bones: My design at this time is to Treat you, First, with the Bones of the upper and lower Mandible, and afterward with all the Bones of the Body not already discoursed.

The Mandibles being Two, are called the upper and lower, making the greatest part of the Face, to which the Muscles are affixed, covered with the *Cutis* and *Cuticula*, which give a great ornament and beauty to the Visage.

The upper Mandible is composed of various fine parts of the inferior and lateral orbits of the Eyes, Nostrils, Cheeks, Palate, and the superior rank of Teeth.

The upper Mandible is composed of many Bones.

It is endued with a semi-circular Figure, adding an elegancy to the Face of Man; and in Beasts it is more long, and in Man and Brutes it is immoveable, except in a Parrot, and Crocodile, and in very few other Animals.

It is accommodated with a hard solid Surface, and inwardly hath a spongy substance, especially near the Teeth, where in Children, a Medullary juyce is conveyed for the nourishment and increase of the Jawe, which being absorbed in persons of more mature age, the Bones remain full of small holes, and endued with greater Caverns, accurately described by Learned Dr. *Higmore*, lib. 3. *Anatom. Parte 2. Cap. 1. Ait ille, Antrum hoc utrinque unum, sub oculi sede inferiore, ubi os ad oculi tutelam quodammodo protuberat, ad latera inferiora nasi situm est. Insigniter Cavum, sphaericum, aliquantulum vero oblongum, & ita amplum, ut articulus pollicis majoris pedis ultimus in illo delitescat. Osse attenuato seu squamma ossea obtegitur: Os enim quod illud includit, & quod a dentium alveolis extremis distinguit, crassitie chartam emponticam non multum excedit. In basi hujus protuberantes quaedam eminentiae cernuntur. Quibus dentium apices tenuiores includuntur. Dentium alveoli margini hujus ossis insculpuntur, quibus dentes insiguntur. Antrum hoc frequentius vacuum aliquando muco repletum reperitur, in quod humores a capite per meatum quendam a cavitate illa in osse frontis, & ab osse Ethmoide destillare poterunt.*

The upper Mandible is endued with a double substance.

The greater Cavern of the upper Mandible.

Each upper Mandible is composed of Six Bones, The First doth constitute one part of the *Os Jugale*, and somewhat of the Temple, and doth comprehend some part of the Eye-brow, and all the exterior angle of the Eye, and a great part of the Cheek.

The Bone of the upper Jawe.

This Bone is conjoyned to the Temple by the interposition of a Suture which conjoyneth the Two Processes, making the *Os Jugale*; and is connected to the *Os Cuneiforme* by the help of that Suture, which passing down the hollow of the Temple, may be seen in the seat of the Eye; This Bone is common to the first Bone of the upper Jawe, and to the *Os Cuneiforme*.

The conjunction of the Bones of the upper, to the adjacent contiguous Bones.

In its upper region it is tied to the Bone of the Forehead in that part, which is accounted the Extremity of the Eyebrow. And this Commissure is made by the benefit of that Suture, which taketh its progress from the hollow part of the Temple through the seat of the Eye to the middle of the Eyebrow, and distinguishes the Bone of the Forehead from the upper Mandible, and the *Os Cuneiforme*; and in its lower Region, the First Bone is joyned with a great largeness to the Fourth, by the means of this Suture.

In the Anterior part of the Mandible near the Cheek, and in the lower Region of the seat of the Eye, part of the Suture begins (conspicuous in the hollow of the Temple) from the lower end of the Suture, dividing the *Os Cuneiforme* from the First Bone of the Mandible; This part of the Suture descending obliquely downward (and inclining somewhat forward) till it arriveth the lower Region of the Cheek, where it is rough and unequal; but that part which is seated in the Anterior region of the upper Jawe, doth climb obliquely upward, to the middle region of the lower orbite, circumscribing the Eye.

This part appearing in the seat of the Eye, ascends from the middle of the lower orbite of the Eye obliquely backward, through the lower part of that seat, to the lower region of the Suture, distinguishing the *Os Cuneiforme* from the First Bone of the Mandible. And after this manner the First Bone of the upper Jawe is circumscribed, (as Learned *Vesalius* will have it) are connected to Four Bones, *viz.* To the Process of the Bone of the Temple, making one part of the *Os Jugale*, and to the *Os Cuneiforme*, to the Bone of the Forehead, and to the Fourth Bone of the upper Mandible.

The Second Bone being much less then the rest, resembleth the scale of a Fish in thinness, and is lodged in the inward angle of the orbite of the Eye, where the *Foramen* is seated, to which the Caruncle adjoyneth, possessing the inward Angle of the Eye, which is instituted by nature (according to *Vesalius*) lest pituitous Recrements coming from the Brain should bedew the Cheeks, whereupon they are discharged through a hole, leading into the Caverns of the Nostrils.

This Bone is terminated in its upper part, by a small space of the Suture, distinguishing the Bone of the Forehead from the upper Mandible; and by the interposition of that Suture, this little Bone is conjoyned to the Bone of the Forehead; from this Suture another descends (about the hinder region of the little Bone) which passing by the lower part of it, afterward ascends through the Anterior region into the Suture, which distinguishes the Bone of the Forehead from the upper Mandible.

The Suture being carried almost after the manner of a Circle, in the hinder region of the little Bone (which relates to the Cone of the seat of the Eye) is common to the Second, and to the Third Bone of the upper Mandible. And at the lower part of the little Bone, and according to its anterior region, the Suture is common to the said little Bone, and to the Fourth Bone of the upper Mandible; so that the said little Bone in its upper region doth touch the Bone of the Forehead; and in its lower, the Third Bone of the upper Mandible, and in the Inferior and Anterior part the Fourth Bone; and because this Bone is loosely connected, it may be said to be conjoyned in its Anterior part, to the Fourth Bone, by Harmony rather then by Suture. This Bone (called by some *Os Lacrymale*) is endued with a membranous substance, as being the First rudiment of it, as well as other Bones, and cannot be distinguished from the Origins of the adjacent Bones for many Months, till it arrive to a Cartilaginous and Bony nature.

The First Bone of the upper Mandible is connected to Four Bones.

The Second Bone of the upper Mandible.

The conjunction of the Second Bone of the upper Jawe to the Bone of the Forehead.

The

The Third Bone of the upper Mandible (as well as the Second) resembles a Scale in thinness and transparency, and being broken, may be seen in its inward Recesses, to be beset with numerous *Sinus*, as so many Cells of Air, and seemeth to be endued with a kind of Quadrangular Figure, and seated in the inward side of the orbite of the Eye; and is terminated above by the Suture, common to the Bone of the Forehead, and the upper Jawe. In the Anterior region it connects the common Suture with the Second Bone of the Superior Mandible, and behind it adjoyns to the common Suture with the *Os Cuneiforme*; and in its lower part is endowed with the common Suture, and with the Fourth Bone of the Jaw; so that this Third Bone is conjoyned to Four Bones, above, to the Bone of the Forehead, before, to the Second Bone of the Mandible, behind, to the *Os Cuneiforme*, and below, to the Fourth bone of the Jawe; and inwardly where it relates to the Nose, it adjoyneth to an irregular Compage of Bones lodged within in the top of the Nostrils.

The nature of the Third Bone of the upper Mandible.

The connection of the Third Bone of the upper Jawe, to the adjoining Bones.

This Bone putteth on first a membranous, and then a cartilaginous Nature, and at last grows bony at the end of the Second Month, wherein all other Bones have a soft substance, as having not arrived a bony substance.

The origin of this Bone.

The Fourth Bone of the upper Jawe exceedeth all the rest in dimensions, and receiveth all the Teeth relating to one side, and is circumscribed with various Sutures, The First Suture terminates, where it distinguishes the first Bone of the Jawe from this, which is seen in the Cavity of the Temple, and in the Anterior region of the Mandible, and in the orbite of the Eye; And the Fourth Bone is circumscribed by Sutures, distinguishing the Second and Third Bone from this, which take their progress the whole length, and the lower part belonging to the orbite of the Eye, and the Anterior region of the Second Bone of the Jawe.

The Fourth Bone of the upper Jawe.

This Bone also adjoyneth to the middle of the Eye-brow, about the Suture, distinguishing the upper Mandible from the Bone of the Forehead, by a space relating to the fore-part of the Second, to the out-side of the Fifth Bone, from which the Fourth is distinguished by a Suture, extended from the top of the Nose, according to its outside, downward the length of the Fifth Bone.

The connection of the Fourth Bone to other Bones.

This Bone, according to the whole length of the Nose, from the top to the bottom, is distinguished from the Bridge by a Suture, passing to the lowest region of the Nostrils, and in the lower region this Bone adjoyneth to the *Os Cuneiforme*, and in the orbite of the Eye, and in the inmost Tooth, where the Suture is seated, parting the *Os Cuneiforme* from the upper Mandible.

The Fourth Bone in the termination of the Palate, bending inward, is disjoyned by a transverse Suture from the Sixth Bone of the Jawe, which is seated at the hole of the Nostrils. And the Fourth Bone hath all these Sutures, common to the adjacent Bones; and another Suture may be seen, which is proper to the Fourth Bone (belonging to the Right and the Left side) and passeth the length of the Palate, and is not only conspicuous in it, but in the Cavity of the Nostrils.

According to Ingenious *Vesalius*, this Bone adjoyneth to Seventeen Bones, First, to the First, Second, Third, Fifth, and Sixth Bones of the upper Jawe, and also to the Bone of the Forehead, *Os Cuneiforme*, and to the Eighth Bone of the Head, the Bridge relating to the Nostrils; and this Bone is also conjoyned to the Fourth Bone of the other side; As also to Eight Teeth, fastened

This Bone adjoyneth to Seventeen Bones.

fastened into the upper Mandible, where it is adorned with Sixteen Teeth.

This Bone constitutes for the most part, the sides and lower region belonging to the Caverns of the Nostrils; one hole is found (beside many others) beginning from the lower region of the orbite of the Eye, and is extended to the fore-part of the Mandible, and when it first begins in the orbite of the Eye, it composed above a good space, as of a bony Scale, and where it relates to the fore-part of the Jawe, it is more deeply engraven into the Bone; and an eminent space is worthy our remark, which is conspicuous about the circumference of the Eye, and the upper part of the hole; this space is not always continued, but is endued with a Suture, which is proper to a particle of the Fourth Bone, where the hole is seated: Farthermore, in the fore-part of the Palate, at the lower region of the Incisory Teeth, another hole may be discovered, common to Four Bones of the upper Jawe, and relating out of the Palate to the Caverns of the Nostrils; About the sides of this hole appears a Suture, or rather a line filled with a gristle, which seemeth to belong to the fore part of Dogs Teeth, and doth penetrate so deep, as to divide the Fourth into many Bones, which relates to Apes and Hogs; in which a Suture dividing the fourth Bone into Two, is seen, not only inwardly in the Palate, but externally too in the fore part of the Jawe, not resembling any kind of conjunction of appendices with their Bones.

The Fifth Bone of the upper Jawe is composed of Two Bones.

The Fifth Bone of the upper Mandible (according to *Vesalius*) is composed of Two Bones of the Nose, the one is a little, slender, oblong Bone, endued with a kind of triangular Figure; by reason in its upper region it doth not terminate into an acute angle, but is so blunt, that it seemeth to be endued with a double angle, circumscribed with a Suture, which distinguisheth the Bone of the Forehead from the upper Mandible.

The outside of this Bone obtains a Suture (common to the Fourth Bone of the Jawe) which passeth down the side of the Nose, according to the length of this Bone, which is much shorter in Man, then in Dogs and Apes. The inside of this Bone (which is conjoyned to the Fourth Bone of the other side) hath a Suture (much resembling a harmony) common to both Bones of the Nose. This Suture (taking its rise about the middle of the Eyebrows, from a Suture, common to the Bone of the Forehead, and the upper Mandible) passeth downward the length of the Bones of the Nose. In the Inferior part, the Fifth Bone is not divided by a Suture, nor conjoyned to another Bone; and being united to the Fifth Bone of the other side, is very rough and unequal in its surface, and terminates into a Cartilage, which groweth softer toward the extremity of the Nose.

The origen of the Fifth Bone.

In the Third Month, the Fifth Bone of the upper Jawe (for the most part) is also first membranous, and afterward groweth grissly, and begins its ossification in a line, and then by degrees becomes more and more bony in the Fourth, Fifth, Sixth, Seventh, and Eighth Months, wherein it obtains a due Magnitude, Figure, and Substance.

The Sixth Bone of the upper Mandible being conjoyned to its pair of the other side, makes a great part of the Palate and Nose, and is seated at the extremity of the Palate, where the Nostrils do perforate the Palate near the Fauces; this Bone hath a thin and broad, but solid Compag, and in its hinder region is connected to the *Os Cuneiforme* (and is partly free from any conjunction) resembling a kind of semi-circular Figure.

Where it is conjoyned to the *Os Cuneiforme*, it is circumscribed with a Suture, and carried to the inmost Tooth; and distinguishes the upper Jawe from the *Os Cuneiforme*, where it emits its Processes, resembling the wings of Batts.

Batts. In its Anterior part and outside, the Sixth Bone is terminated by a Suture, common to it and the Fourth Bone, passing cross-ways in the Palate.

In the Interior region, where it is united to its pair (seated in the other side) it is circumscribed with a Suture, common to the Six Bones ; and a portion of this Suture being extended the length of the Palate, doth sever from each other the Fourth pair of Bones.

The Sixth Bone is joyned to the *Os Cuneiforme*, the Fourth pair of Bones, and to the bridge of the Nose, which is also severed from the Sixth Bone by a Suture, which passeth by the lower region of the bridge, as it hath been expressed before.

C H A P. LXXX.

Of the lower Jawe.

The lower
Jawe is short
in Man, and
is of a solid
substance.

The lower
Mandible is
full of *Sinus*.

The situation
of the *Sinus*
is near the
Chine in Man.

The lower
Jawe is one
entire Bone.

The Jawe in
Embryos seem-
eth to be
composed of
Two Bones.

The termina-
tion of the
lower Jawe
is beset with
a Process.

The Figure of
the hinder
Process of the
lower Mandi-
ble.

The Cavity of
the lower
Mandible.

It is endued
with Four
holes.

MAN, the most excellent of all Animals is endued with a short lower Mandible (if reference be had to the bulke of his Body) which is made by his round Face, which is long in other Animals, who support themselves with Aliment, by depressing their Heads toward the ground, and it is made of a hard solid substance, that it might well comport it self with strong motions in biting and eating; and lest these Muscles should be discomposed with over-much weight of the Jawe, Nature hath wisely contrived many *Sinus*, or Cavities in the lower Mandible, filled with Marrow.

These *Sinus* are not engraven in the lower region of the Jawe in Man, as in Beasts, but more toward the Chin and Sides of the Jawe; and in most Animals it is composed of Two Bones, conjoynd in the top of the Chin; but in Man the lower Mandible is composed of one Bone, which in the higher region of the Chin is thick and broad, and not ending into a kind of Cone as in other Animals.

And in an Embryo the lower Jawe seemeth to be compounded of Two Bones (not yet come to perfection) by reason some part may be membranous or cartilaginous, as not perfectly ossified; yet when the lower Mandible is rendred mature, as in every part becoming bony, it is very conspicuous to be one entire Bone; and upon this account the *Occiput* in Embryos may be said to be many Bones, as consisting of many parts, some membranous, other cartilaginous, before they are perfectly turned into Bone, and after the same manner every Verteber of the Spine, in its origination, may be conceived to be composed of many Bones, before the membranous and grisly parts become bony, which is found in Children of more mature age.

On each side toward the termination, the lower Jawe is furnished with a Process rising upward, which by some receive the appellative of Horns, and the Anterior of these Processes is thin and broad, and terminates into a Cone, called by the *Greeks* *κορυμβή* to which the Tendon of the temporal Muscle is firmly affixed; from whence the luxation of this Mandible, is thought to be very dangerous.

The hinder Process being endued with a more obtuse Figure, is accommodated with a Neck, and oblong little Head, (called *Condylus* by the *Latines*) and is covered with a Cartilage, instituted by Nature, in order to a more easy motion; with which it is also inarticulated with a *Sinus* of the *Os petrosum*, to which it is firmly conjoynd by a membranous ligament.

Inwardly the lower Mandible hath a Cavity engraven in it, containing a Medullary substance, giving nourishment to it, as some imagine.

It is endowed with Four holes, of which, one is seated inwardly on each side of the Processes, and convey an Artery, Vein, and Nerve to the Teeth; and the Two other outward holes are engraven on each side of the Chin, transmitting the branches of Nerves outwardly to the lower Lip, and to its Muscles and Skin.

In the Anterior and middle region of the Chin, the lower Jawe is rendred rough, with a little protuberance, ordered by Nature for the more firm insertion of Muscles, and to this end it hath shallow, both inward and outward *Sinus*, about the origins of the Processes.

The roughness of the lower Jawe.

The lower Jawe is also engraven with many Cavities, as so many repositories of the Teeth, of which there is no certain number, by reason some are endowed with more, and others with less, according to the various number of Teeth and their roots, which in some are double and treble, and in others quadruple, each of which doth challenge a proper Cell in the Mandible.

The lower Jawe hath many Cavities, as so many locuments of the Teeth.

These allodgments of the Teeth do sometimes decay, (and other times grow again) by reason a Tooth being pulled out, its Cavity is so contracted, that its sides do coalesce, and its footstep is obliterated, and groweth so hard, that it performeth the office of a Tooth, and now and then, about the Fiftieth and Sixtieth years of a Mans age, the Teeth called *Sapientia* by the *Latines*, do grow again, boring new holes in the lower Mandible; and in Children when Teeth are shed, it often happens, when the former Cavity is closed, a new one is engraven.

The Bones of the lower Mandible may be called soone-ripe, by reason some part of them is formed the Second Month; and its Figure is very remarkable, as well as that of the Temples, and at this time, being framed of Two Bones, doth terminate within the Nose into an acute Cone, which is very Prominent without the Bone of the upper Jawe, as being a Rudiment out of which the Figure of the Chin is to be formed.

The Bones of the lower Jawe are formed the Second Month in a Fetus.

When the dimensions of the Head are enlarged, the Bones of the Temples are dilated, and in which, one of the Horns, (called *κονδυλωδης*) doth inhere, and the pointed Process is diminished, till it is not extended beyond the Cone of the upper Jawe.

The horn of the Jawe, called *κονδυλωδης*.

Into the other Horn of the lower Mandible, (called by the *Greeks* *κορωνη*) the Tendon of the temporal Muscle is implanted, and is a Bone (severed by a Suture from the other part of the Jawe) descending to the Cavities of the Teeth, and terminates into an acute point.

The horn of the lower Mandible, called *κορωνη*.

And in truth the lower Mandible, the Third Month seemeth to be formed of Four Bones (which may be more properly said to be Four parts of one Bone, not come to maturity) Two of which are conjoyned by the union of a Cartilage; and the Two other Horns (before recited) are united by the interposition of a Membrane.

The lower Mandible in the Third Month, seemeth to be composed of Four Bones.

The First Rudiment of the lower Jawe, as well as other Bones, is First Membranous, and then Cartilaginous, and afterward Bony; so that the Second Month, Two Bones may be discerned, as only Two parts of it are ossified; and in the Third Month Four Bones appear, as more parts of the Jawe are rendred bony; and about the last Month, when the Jawe is accomplished, as the Membranous and Cartilaginous parts are turned bony, the whole Mandible is made one entire Substance and Bone.

The Origin of the lower Jawe.

The *Os Hyoides*, (called sometimes *Ypsiloides*, and *Lamdoides*, as it resembles the Greek Letters of ψ , and λ .) is composed of many Bones, which are most commonly Three, and seldom more; and then diverse of them too are rather Cartilages than Bones.

The *Os Hyoides* is composed of many Bones.

The middle Bone, as the Base of the other, is more broad and large than the rest, being outwardly of a Convexe, and inwardly of a Con-

The middle Bone of the *Os Hyoides*, and its Figure.

cave

The Bones
seated on
each side, re-
semble horns.
Four Cartila-
ges are united
to these Bones

cave Figure; the other Bones (seated on each side) are conjoyned to the middle Bone, and resemble horns in shape; Four small Cartilages are united to these Bones, of which, Two are seated at the Base of the little Bone, some like a grain of Wheat in shape and size: The Two other Cartilages are placed about the side Bones, and conjoyned with a nervous Ligament to the Styloform Process, to which the Horns of the *Os Hyoides* do adjoyn side-ways, and in its fore-part to the Buckler Cartilage, and Tongue, and entertains the *Epiglottis* into its *Sinus*.

The use of the
Os Hyoides.

The eminent use of this little Bone may be to underprop the Lungs, and preserve it in its due situation; and to be a center of Motion to diverse Muscles (Ministerial to the motion of the Tongue) which are implanted into the *Os Hyoides*.

CHAP.

C H A P. LXXXI.

Of the Bones of the Scapula, Shoulder or Arm, &c.

THE Bone of the *Scapula* (called by the *Greeks* *ἀσπλάγην*, is lodged on each side upon the Ribs, like a Buckler, and is thin and broad, adorned with a kind of triangular Figure, and is endued with a Concave Surface within, and with a Convex without; and is instituted by nature, not so much for the guard of the hinder region of the *Thorax*, as the inarticulation of the Shoulder, and the implantation of diverse Muscles, fastning the *Scapula* to the Ribs, and *Occiput*, to which it is tied, and some Spines relating to the vertebres of the Neck above, by the *Musculi Cucullares*, taking their rise from the hinder part of the Head, and from the Apices of Fourteen Spines, whereof Five belong to the lower spondyles of the Neck, and Nine to the upper Vertebres of the Back, and is inserted into the whole Spine of the *Scapula*, so that this Bone is firmly tied by the *Musculi Trapezii* to the *Occiput* above, and lower, to some of the Vertebres of the Neck and Back; this Bone is also affixed to the Neck, and hinder parts of the Trunk, by the *Musculi Rhomboides* (lodged under the *Cucullaris*) which borroweth its origen from the Spines of the Three lower Vertebres of the Neck, and the Three upper of the *Thorax*; and this Muscle is inserted into the outward Base of the *Scapula*; whose Bone is also tied forward to the Four upper Ribs, by the *Musculus serratus minor*, lying under the pectoral, which taketh its origination from the said upper Ribs, and is extended to the *Processus Coracoides* of the *Scapula*; This Bone is also connected to the transverse Processes of the Second, Third, and Fourth Verteber of the Neck.

This Bone is affected with great variety of parts (making a great unlikeness to it self) as having diverse Processes, *Sinus*, Appendices, and resemble a kind of Triangle, by reason of diverse unequal sides, of which the First, (being called the Base †) is that region of the *Scapula*, which passing in length along the Back, adjoyneth to the Spines, relating to the Vertebres of the *Thorax*, and is formed of an oblique line, inclining above and below toward the ambient parts, making the Convex of a Circle, and is somewhat hollow and semi-circular in the middle.

The lower side of the Triangle (relating to this Bone) maketh its progress from the lower region of the Base obliquely upward toward the outward parts. But the upper side of the Triangle (being as much shorter then the lower, as the lower then the Base) passeth downward toward the ambient parts, after a kind of transverse posture; both these sides meeting in an angle, do contain the broad part of the *Scapula*, circumscribed with a narrow termination, (called the Neck of the *Scapula*) into which the *Sinus* is engraven, receptive of the head of the Shoulder-bone.

The Basis of the *Scapula* for the most part is very thin, and somewhat thicker about the sides then middle; to this Base, most commonly Two Appendices are conjoyned, one of which being thicker, larger, and longer, is seated at the lower angle † of the Base, and is very blunt, and almost orbicular in its termination.

T. 72. F. 2. d.
The seat of
the *Scapula*.

The Figure of
the *Scapula*
is triangular.

The *Scapula*
is made for
the inarticu-
lation of the
Shoulder, and
implantation
of Muscles.

The *Sinus*,
Processes, and
Appendices
of the *Scapula*.

† F. 2. b b.
The Base of
the *Scapula*.

The lower
side of the
Triangle re-
lating to the
Scapula.
The upper
side of the
Triangle.

The Two Ap-
pendices of
the *Scapula*.
† T. 7. F. 1. 2.
a.

But the other Appendix is placed somewhat under the Superior Angle + of the Base, and is united to it, where the Spine is said to take its Origen.

A Cartilage
appendant to
the Base of
the Scapula.

Beside these Appendices, a soft Cartilage is appendant to the Base, and is much akin to those Cartilages, with which the extremities of Bones are furnished.

F. 2. g.
The Neck of
the Scapula.

The Sinus of
the Scapula.

The Liga-
ments of the
Scapula,
and its Sinus,
covered with
a Cartilage.

The Neck of the *Scapula* + coming out of a thin large Base, groweth more narrow and thick, and this Neck making its progress outward, is dilated; so that it being oblong, is engraven with an oblong *Sinus*, terminated in its lower region into a circular circumference, and in its upper part into an acute. Furthermore, the upper part of the *Sinus* of the *Scapula* is more protuberant, that Two strong Ligaments may more aptly spring out of it; This *Sinus* of the *Scapula* is incrusted with a Cartilage, after the manner of the *Sinus* in other joynts, and is not very deeply engraven; so that its greatness and depth, do not answer the largeness and length of the head of the Bone of the Shoulder (which is received into the *Sinus* of the *Scapula*) by reason of various loose motions, performed in this articulation of the Shoulder-bone, with the *Sinus* of the *Scapula*.

The Sinus is
deepened
with a Carti-
lage.

And Nature hath instituted a kind of Cartilage (endued with the substance of a Ligament) which doth increase and render the *Sinus* more deep, which doth highly correct the laxity of the articulation.

Ligaments
orbicularly
encompassing
the Joynt.

In the circumference of this *Sinus* a Cartilage is seated, not inwardly conjoynd to the head of the Shoulder Bone, and the *Sinus* of the *Scapula*, but only connected to Ligaments, orbicularly encompassing the Joynt, and much resemble the Cartilages (which are found in the joynt of the Knee) not unlike a new Moon in Figure.

The use of the
Cartilage of
the Scapula.

The outward region of this Cartilage is thick, and making its progress toward the center of the *Sinus*, groweth less in dimensions, and terminates before it arrives the Center, as if the *Sinus* should be rendred more large and deep, by the apposition of a ring (to its circumference) which being depressed, did somewhat resemble a Triangle, as the outside of that Triangle did relate to the outside of the circumference of the Joynt, and below the Side did rest upon the *Sinus*, and above it looks toward the head of the Shoulder-bone; so that by the benefit of this Cartilage, the *Sinus* of the *Scapula* becomes more deep, and the Cartilage being of a pliable Nature, giveth way to the force and compression of the Bones, and no way impedes the lax motion of this joynt.

The Three
Processes of
the Scapula.

The First
Process, cal-
led the Spine.

+ F. 2. e.

The *Scapula* is adorned with Three Processes, the First passeth through the middle, all the length, from the Base of the *Scapula* to the Neck of it, and is called the Spine, being a bony ridge made for the safe allodgment of many Muscles, seated on each side of the Spine, whose extremity being conjoynd to the Clavicle, formeth the *ἀκρόμιον* +, called by the *Latines*, *Humeri mucro*.

+ F. 2. f.

The use of
the Crow-bill
Process.

The Second Process of this Bone is seated lower, and is less, and acute, resembling the Bill of a Crow; whereupon it is styled *Κορυμβοειδής* +, which is concave in its lower region, and in its upper rough and unequal, and hath a Prominence, to which the Clavicle is firmly tied, by others this denominated *στυμοειδής* and by other *ἀγρυμμοειδής*, from resembling some part of an Angle: And the use of this strong Process is to preserve the joynt from outward assaults and accidents, offering violation to the Joynt.

That I may give a short History of the parts of the *Scapula*, the Basis, Spine, Neck, the Crow-bill Process, and that of the top of the Shoulder, which must be supposed, to have various degrees of Ossification; and its First rudiment

rudiments, as of all other Bones, is membranous, and in the latter end of the Second Month, is a round Cartilage (not distinguished into various parts) marked in the middle with a white point, which is the beginning of ossification; and this Cartilage terminates into a narrow part (without any distinction) into a long white line placed in the middle, which afterward is formed into the Bone of the Shoulder, distinct from the *Scapula*.

In the Third Month the *Scapula* is adorned with its perfect Figure, and the Spine perfectly bony, and is only encircled above with a Cartilaginous Margent, to which the top of the Shoulder is affixed, which is wholly Cartilaginous, as well as the *Processus Coracoides*, the Neck, and the Base is above half gristly; and its Cartilaginous Margent groweth less, which encircling it the Fourth Month, and the Fifth, and other Months, becomes less gristly; and in its lower region, where it terminates into a point, it is more slowly ossified, because that part is more distant from the center of a circle, which nature makes in its various steps of ossification, and both the Processes of the *Scapula* are cartilaginous for the most part, as well as the *Sinus*, engraven in the Anterior part of the *Scapula*, and the head of the Bone of the Shoulder (relating to it) doth not obtain the solidity of a Bone after the Birth; whereupon a new Born Child lifteth up its Arm with great weakness and difficulty; and the Fissure, or Interstice which passeth between the *Processus Coracoides*, and Base of the *Scapula*, hath no footstep appearing before the Fifth Month, and afterward is more and more hollowed, and adorned with a semi-lunary Figure, and afterward beautified with the shape, found in persons of mature age.

The Bone inarticulated above with a *Scapula*, and below with the Cubit, is called by *Celsus*, *Os Humeri*, and commonly the Bone of the Arm, which in its higher part, (where it is conjoined to the *Scapula*) is adorned with a fair Appendix, or Protuberance, as *Vesalius* will have it, which in truth doth consist in Two heads; of which, that of the inward region is large and orbicular, and protuberant after the manner of above half a Globe; but the outside of the Appendix, hath another rough and unequal Head, not applied to any Inarticulation, but only endued with a Prominence into which many strong Ligaments are implanted, tying the Bone of the Shoulder to the *Scapula*: At the outside of the inward head, that relates to the eminent and upper region of the Appendix; and in the Anterior and Posterior part of this Head, a great *Sinus* is formed orbicularly, distinguishing the inward Head from the outward, and preparing a place fit for the insertion of Ligaments; and into this *Sinus*, (being more enlarged in its Anterior, rather than Posterior part) as into a Valley the Ligaments are inserted, and some are also inserted into the head of the Shoulder-bone, as into a Hill, or Promontory.

The Bone of the Shoulder or Arm, is large, round, and unequal, and more flat and plain in its hinder part toward the Cubit, and hath above, a great orbicular Head (guarded with a soft Cartilage) insinuated into a *Sinus* of the *Scapula* encircled in its outward circumference with a gristle, rendring the *Sinus* deeper and larger for the more firm Inarticulation of the Shoulder-bone insinuated into the *Sinus* of the *Scapula*, encompassed with Ligaments.

In the hinder part of the great Head of the Shoulder bone, may be found Two rough and unequal Prominencies, to which strong Ligaments are affixed; these Protuberancies are attended with Two *Sinus*, of which one is orbicular, seated at the side of the great Head, and is the origin of a Ligament; the other *Sinus* is outward, and oblong, (parting the said Prominencies.

The Bone of the Shoulder or Arm.

The Appendix of the Shoulder-bone, one Head is large and orbicular. The Second rough Head into which strong Ligaments are implanted.

The description of the Shoulder-bone.

The hinder part of the Shoulder-bone hath Two Prominencies, attended with so many *Sinus*.

minencies) is the seat of the origen of the Muscle, called *Biceps*.

The lower region of the Shoulder-bone, is articulated with the *Ulna* and *Radius*.

The lower region of the Bone of the Arm is Inarticulated with Two Bones, the *Ulna* and *Radius*, and is adorned with an obscure Appendix in Children, but is more conspicuous in persons of more mature age, beautified with variety of protuberancies, *Sinus*, endued with diverse shapes and sizes.

A *Sinus* appearing in the middle part of the Bone, with its Prominencies, resembling the little wheel of a Pulley.

In the middle of the lower part of the Bone (relating to the Arm) a *Sinus* may be seen with its Prominencies, resembling a little wheel of a Pulley, by reason this wheel is orbicular in its circumference, and in its sides broad and plain; so after the same manner in the lower region of the Shoulder-bone, a plane, or round part may be discerned, which is not unlike the small wheel of a Pulley; Farthermore, as in the wheel (where the cord is placed) a *Sinus* is engraven, and the sides are every where protuberant about the *Sinus*, which do equally receive the rope, lest it start out of its place. So this part of the Shoulder-bone hath a *Sinus* engraven into it, protuberant on each side: and differeth in this, from the Prominencies of the wheel, because the sides belonging to the *Sinus* of the wheel are equally protuberant; but this part of the Shoulder-bone in its inside is very prominent, and exactly answers the wheel of a Pulley; but in the outside it is much more flat, and depressed, which is occasioned by the head of the Shoulder-bone, inarticulated with the *Radius*, which is seated at the outside of the orbite of the Shoulder, without any eminent Prominence, which together with the *Radius*, doth hinder the outward Luxation of the *Ulna*. But in the upper part of this orbite, or wheel (as Learned *Vesalius* calls it) Nature hath engraven Two eminent *Sinus*, one in the fore, and the other in the hinder part of the Shoulder, much deeper and larger then the former; These *Sinus* being parted, as it were with a long scale, do receive the Procceses of the *Ulna*, which are very conspicuous in its upper part; and the Anterior Protuberance (when the Cubite is bent) doth admit the Anterior *Sinus*; and when the Cubite is extended, the Posterior *Sinus* of the Shoulder-bone doth receive the Posterior Procces of the *Ulna*: And these *Sinus* are terms of the extreme Flexion and Extension, contrived by the grand Architect, that the Cubite may be brought to a most acute angle in Flexion, and cannot be extended beyond a right line; and the *Sinus* of the lower region of the Shoulder-bone, are Bases and Obstacles, hindring the luxation of the Joynt in violent motions.

The articulation of the lower part of the Shoulder-bone with the *Radius*, is made per *Ginglynum*.

The Articulation of the lower region of the Shoulder-bone, with the upper of the *Ulna*, may be styled *γυμνωσις*, from the resemblance of Hinges, containing each other in mutual embraces; so that the parts of the said Joynt, in reference to *Sinus* and Procceses, do receive, and are received, as the Procceses of several Bones are mutually entertained into the various *Sinus* of others.

The head of the Shoulder-bone is received into the *Sinus* of the *Radius* where it is firmly articulated, so that it cannot slip out of the socket, in the motions of Flexion and Extension.

At the outside of the orbite of the Shoulder-bone, is seated an oblong roundish head (lined with a Cartilage) insinuated into the upper *Sinus* of the *Radius*, and by the help of this Inarticulation, the said Bone, as furnished with antagonist Muscles, may be put into supine and prone positions; and the length of this Head (passing toward the body of the said Bone) giveth it a more firm articulation; that in the Flexion and Tension of the Cubite, the head of the Shoulder-bone cannot easily slip out of the socket of the *Radius*.

And upon this account, the head of the lower part of the Shoulder-bone, is incrusted with a soft Cartilage, to give a more free play to it in the *Sinus* of the *Radius*, to prevent the grating of the head of one Bone against the *Sinus* of the other.

And

And at the outside of this Head it is very protuberant, and from an acute line, passing along the outside, various Muscles take their origins, making several motions in the joynts of the Fingers, and not only the outside of the Head is protuberant in the lower region of the Shoulder-bone, but from the inside of its Orbite an acute Process, (called the inward Tubérance) is wisely so med by Nature, not for any inarticulation, but upon the account of the origination of Muscles, and progress of Nerves.

The middle part of the Shoulder-bone running in length, seemeth to be adorned with a round Figure, and is somewhat depressed, and larger toward the lower region, then in the Anterior. Farthermore, this Bone is round in some parts, and depressed in others, endued with Concave and Convex Surfaces in several Regions, of which some parts are plane, and others rough, for the better insertion of Muscles.

The Figure of the body of the Shoulder-bone.

Any considerable holes cannot be found in the Shoulder-bone, except some small ones which are engraven about the margent of the *Sinus* and Processes, for the more firm originations or insertions of the Ligaments; and about the sides of the Shoulder-bone, some holes may be discovered for the transmission of Blood-vessels to, and for the Marrow contained in the Cavity of the Bone.

Some small holes are found about the *Sinus*, for the implantation of Ligaments.

In the Second and Third Month of a *Fœtus*, appears no articulation of the Shoulder-bone above with the *Scapula*, nor of it below with the *Radius* and *Ulna*, which are first Membranous, and then Cartilaginous; and the Origin of the Shoulder-bone first may be seen in a long line; the first rudiments of the *Ulna* and *Radius* may be discerned in Two long lines, which are the first steps of Ossification, which groweth first in the middle, and afterward the sides are rendred bony; and last of all, the Joynts are formed of the Shoulder-bone above with the *Scapula*, and below with the Bones of the *Ulna* and *Radius*.

And the Bone of the Shoulder in its first origination, is endued with a Cavity (the repository of Marrow) which is encircled first with membranous, and then Cartilaginous substance, which afterward becomes bony, whose ambient parts are most hard, and inwardly more spungy.

The Cubite is framed of Two oblong round Bones, called *Ulna* and *Radius* by the *Latines*. The First being the *Radius* † is seated near the orbite of the lower region of the Shoulder-bone, with which the *Ulna* is articulated, as endued with Processes, insinuated into the *Sinus* of the Shoulder-bone; The *Ulna* being thick and solid in its upper region, obtains Two eminent Processes, of which the Anterior looks toward a *Sinus*, engraven in the Shoulder-bone; and the *Ulna* hath its Processes fitted to the said *Sinus*, which is large, and furnished with an obtuse Angle.

The Two Bones of the Cubite.
† F. 1. D D.
The First is the *Radius*, F. 1. E E.
The Second is the *Ulna*, endued with Two Processes.
The Anterior Process.
The hinder Process of the *Ulna*.

The hinder Process of the *Ulna* (somewhat resembling the Anterior in Figure) doth enter into a *Sinus*, made in the hinder region of the Shoulder-bone; this *Sinus* is larger and deeper then the Anterior, and hath the forme of an obtuse Angle. The hinder Process is styled by *Galen* ὀλέκτρον, and ἄγκυον by *Hypocrates*, and the Elbow in *English*.

In the middle of these Processes, a great *Sinus* is engraven, receiving a Process of the Shoulder-bone (called *Rotula* by *Vesalins*) this *Sinus* answers the Process in largeness, and is adorned first with a semi-circular Figure, somewhat resembling a C, and that it might more agree with the *Rotula* of the Shoulder, it is endued in the middle with an obtuse Protuberance, which maketh its progress in length, and is compressed on each side, and rendred sinuous, which *Vesalins* resembles to the round Concave of a Wheel (rela-

A *Sinus* seated in the middle of the Processes of the *Ulna*.

ting to a Pulley) receiving a Cord. After the same manner the substance of the *Sinus* of the *Ulna*, is somewhat like the Cord placed in the *Sinus* of the Wheel, belonging to a Pulley, as the Learned Author will have it.

The *Sinus* is lined with a Cartilage.

A great part of this *Sinus* (appertaining to the *Ulna*) is smooth and lined with a Cartilage, and is so fitted with its Processes, to the Wheel of the Shoulder-bone, that the Cubites may be safely extended, and bent, without the danger of the luxation of the joynt, which is very much promoted by the mutual ingress of diverse Bones, and the strong ties of Ligaments, arising out of many rough Prominencies, with which the Bone of the Shoulder and *Ulna* are adorned, for the better implantation of Ligaments and Muscles.

The articulation of the *Radius* with the Shoulder-bone, making Pronation and Supination.

But the *Radius*, the other Bone of the Cubite, is slender, where it is conjoyned to the Bone of the Arm, or Shoulder, and out of an oblong slender Neck, groweth into a large orbicular Head, and in that part that looks toward the Shoulder-bone, it hath a round *Sinus*, not very deep, into which the head of the Shoulder-bone is received; by this Articulation the Cubite receiveth diverse postures of prone and supine, while the *Ulna* lieth quiet, as not acted with any motion; and the Articulation of the *Radius* with the Shoulder-bone, doth not hinder the Flexion and Extension of the Cubite, performed by the Articulation of the *Ulna*.

By reason the length of the Head of the Shoulder-bone is so great, and in its lower region is endued with such a smooth and slippery Cartilage (easily giving way to the motion of the Joynt) that the *Sinus* of the *Radius* is not disjoyned from the head of the Shoulder-bone (when the motion of the Cubite is celebrated in pronation and supination) which is very much assisted by strong Ligaments, encircling the Joynt, and keeping it in its due place.

The progress of the *Radius*.

The *Radius* is conjoyned to the *Ulna*, both above and below, and taketh its progress in the middle, after the manner of an Arch, that it might be disjoyned from the *Ulna*; that the *Radius* in its oblique situation, might be under-propped by the *Ulna*, which may the more easily exert the various motions of pronation and supination, and partly, that a fit allodgment might be made for Muscles in the outward and inward region of the Cubite.

A *Sinus* engraven in the outside of the *Ulna*, and passeth transversely.

At the outside of the upper part of the *Ulna*, near the Process of the Shoulder-bone, a *Sinus* is engraven (passing transversely the Fourth part of a circle) which is smooth, and incrusted with a Cartilage; to this *Sinus*, the inside of the head of the *Radius* (for which the *Sinus* is formed) doth most fitly agree, and being the head of the *Radius* is made smooth and orbicular, and doth easily turn in the *Sinus* of the *Ulna*: But below, near the Wrist, where the *Radius* groweth greater, and is dilated, as with an eminent Appendix, a *Sinus* is formed in the lower region of this Protuberance, not unlike that which is engraven in the *Ulna*; In this *Sinus* lined with a Cartilage, the upper region of the Appendix of the *Ulna* (being protuberant after the manner of a head, and covered with a gristle) is revolved; and upon this account, the *Radius*, by the help of both Joynts, doth celebrate a prone and supine posture.

A *Sinus* engraven in the *Radius*, near the Wrist.

Not far from the upper Joynt, where the neck of the *Radius* is seated, it emits a rough Process (looking toward the inner region of the Cubite) which maketh a fit seat for the insertions of the Flexors of the Cubite: Furthermore, the *Radius* in its progress from the Shoulder-bone toward the Wrist, is not perfectly round and smooth, but according to its length, in reference to the lower region, doth produce a prominent line, which looking toward the Third line of the *Ulna*, doth receive a Ligament, tying together the bones of the Cubite, (that they should not part) after the manner of a strong bandage,

bandage, and the outside and inside of this line is reduced flat and hollow, that it might make fit allodgments for the Muscles of the Cubite; And the *Radius* groweth thicker and broader in its lower region, to make a fit articulation with the *Carpus*, it being requisite, that the joynt made in the lower part of the Cubite with the *Carpus*, should almost wholly be referred to the *Radius*, by reason the *Ulna* resting at the Shoulder-bone belowe, the hand may obtain a prone and supine posture by the help of the *Radius*; by reason, if the *Sinus* receiving the Wrist, was equally engraven in the *Ulna* and *Radius*; it is impossible the Hand should have its back and palme put into various positions, when the *Ulna* rests, as a Base and Fulciment of this motion; and the part of the Wrist inarticulated with the *Sinus* of the *Ulna*, would prove an obstacle, that the *Radius* could be moved, when the *Ulna* lieth quiet; Therefore Nature hath provided a large Appendix, into which the *Sinus* of the *Radius* is engraven, and by reason this small Bone could not be very much enlarged, part of the Wrist is sustained by the *Ulna*, to which its acute Process is somewhat assistant, though it touch the Wrist but in a point; And by reason lest the *Ulna* in the other region of its Appendix, should be conjoynd to the Wrist, without the interposition of some other body, Nature hath emitted a Cartilage (from the lower part of the *Sinus*, engraven in the Appendix of the *Radius* for the benefit of the Wrist) which climbing up the Appendix of the *Ulna*, doth part it from the Wrist, and fits the Joynt, that the *Ulna* may in some sort support the Wrist, and doth not immediately touch it, by reason the whole *Sinus* belongs to the *Radius*, out of which do proceed strong Ligaments for the preservation of the Joynt.

Part of the Wrist is articulated with the *Sinus* of the *Ulna*.

The *Ulna* is conjoynd to the Wrist by the interposition of a Cartilage.

The Articulation of the *Carpus* with the *Radius* is not performed by one, but three Bones (which look toward the *Radius* and *Ulna*) of which two belong to the *Radius*, and the third Cartilage (properly springing out of the *Radius*) chiefly relates to the acute Process of the Appendix of the *Ulna*; and the *Sinus* of the *Radius* appears to be double, because it is somewhat protuberant, where it is conjoynd to the Second Bone of the Wrist.

The articulation of the *Carpus* is performed by Three Bones.

The external region of the *Radius*, as well as *Carpus*, is Convex, that it might resist outward accidents; and that the Tendons of Muscles taking their progress to the Hand, and being derived from the gibbous part of the *Radius* should lose their way, many *Sinus* are engraven about this region, through which the Tendons (covered with transverse ligaments) should pass, as through so many rings.

The Tendons of the Muscles pass through an annular *Sinus*.

And there are no holes in the bones of the Cubite, except these which are ministerial to the Origins of the Muscles, and are endued with a firm solid substance, except the Appendices which are more spongy, and have a large *Sinus* engraven in their inward penetrals (encircled with bony Walls) fit for the reception of Marrow, and to render the Bones light, lest they should be a burden in progressive motion.

The Great Masters of our Faculty, *Galen* and *Hypocrates*, called the Arm from the *Scapula* to the extremity of the Fingers *χεῖρ*, but the *Latines* and more modern Anatomists, *Manum appellant*, call a Hand the part that joyns to the *Cubitus*, and end at the terminations of the Fingers.

The accretion of the Hand according to the Antients.

The Hand, according to this acception may be distinguished into Three parts, *Carpum*, *Metacarpum*, and *Digitos*. The first part called by the *Greeks* *καρπός*, is composed of Eight Bones, endued with diverse shapes, sizes, and situations, in which not one Bone answers another exactly, and yet they are so curiously conjoynd (*ad Harmoniam*) that they may seem, after a manner, to be one entire Bone, and cannot easily be parted, unless you cut the Membranes

The Three parts of the Hand.

branes and Cartilages, by which they are mutually affixed; and being finely set together (as adapted to each other with curious Artifice) are adorned with a double surface, in their upper region with a Convex, and in their lower with a Concave; and both above where they being conjoined to the Bone of the Cubite, and below to the *Metacarpium*, are smooth, and incrufted with Cartilages; and are also encompassed with gristles where they are coarticulated in Heads and *Sinus* with each other, Eight in number.

† T. 71. F. 1.
G G.
The Wrist is
framed of two
ranks of
Bones.

The seat of
the First and
Second Bone
of the *Carpus*.
The Third
Bone.

The Fourth
Bone of the
upper row.

The articula-
tion of the
First Bone of
the upper
rank, is arti-
culated with
the *Radius*.

The Con-
nection of the
First Bone.

The connecti-
on of the Se-
cond Bone of
the *Carpus*.

The articula-
tion of the
Third Bone
with the
Fourth and
Eighth Bone
of the Wrist.

The Fifth
Bone is arti-
culated with
the First.

Nature hath framed two ranks of Bones, making the Wrist, by which the First is conjoined to the *Radius*, and the Second to the *Metacarpium*, and the First Bone of the Thumb. The First, Second, and Third Bone of the higher row of Bones, are so closely united to each other, that they seem to constitute but one broad Bone, and are in part received into the *Sinus* of the *Radius*, making a joynt in the lower region of the Cubite. The First and Second Bone of the *Carpus* are reposed in a *Sinus*, engraven in the Appendix of the *Radius*, and the Third doth rest upon a Cartilage, taking its rise from the *Radius*, and doth partly distinguish the *Ulna* from the *Carpus*, and the outside of the Third Bone, doth touch the acute Process of the Appendix of the *Ulna*, when the Head is moved outward.

The Fourth Bone of the upper row of the Wrist doth not lean upon the *Ulna*, but in its upper region doth receive that part of the Ligament (belonging to this Joynt) which taketh its Origen from the acute Process of the Appendix, relating to the *Ulna*: And into the upper region of the Fourth Bone of the *Carpus* is inserted a Tendon of a Muscle, called the inferior Flexor of the Wrist; and out of the lower part of this Bone ariseth a Muscle, stiled the *Abductor* of the little Finger. And this being proper to the Fourth Bone, is conjoined only to one Bone of the Wrist, and is less protuberant, and hollowed then the rest, as being the least of the Bones.

The First Bone of the upper rank of the Wrist is articulated with the *Radius*, and conjoined to the Second Bone, as it insinuates its large Head into the *Sinus* of the Second Bone; and with another more large Head (coming from its lower region) enters into a common *Sinus*, engraven into the Fifth and Sixth Bone of the Wrist.

And the First Bone is not only adorned with diverse Heads, but with a large *Sinus* too, by which it is conjoined to the head of the Seventh Bone, and to the Second, Fifth, Sixth, and Seventh.

The Second Bone is connected to the First Bone, and to the Seventh, and to the Third, with a great plane surface; so that the Second Bone is conjoined to the lower region of the *Radius*, and to the First, Third, and Seventh of the Wrist, and adjoyneth to the Eighth Bone.

The Third Bone of the Wrist, or *Carpus*, is not only articulated with the Fourth, but enters into the *Sinus* of the Eighth Bone, with a large Head; and it is farther conspicuous upon Dissection, that this Bone is conjoined to the *Ulna* by a peculiar Cartilage, and to the Second, Fourth, and Eighth Bone of the *Carpus*.

The Fifth Bone of the Wrist in its upper region doth receive the Head of the first Bone into its *Sinus*, and being hollowed in its outside, doth entertain the Head of the first Bone into its bosome.

The Fifth Bone of the *Carpus* (being the First of the Second rank of Bones) receiveth the Head of the First Bone into its *Sinus*, engraven into its upper part, and being Concave into its outside, doth admit the Head of the Sixth Bone; and in its lower region is endued with a large oblong *Sinus*, which is engraven also in its inward and outward region, to which the Head of the First

First Bone is conjoyned *per modum Arthrodia*, which is a loose Articulation, requisite to a manifest motion, after a different manner, from the Bone of the *Carpus*, articulated with each other, *per modum Harmonia*, there being no occasion of any great motion in this Articulation; and after the same manner the Bones of the lower rank of the Wrist are connected to the Bones of the *Metacarpium*; the *Metacarpium* adjoyning to the first Bone of the first Finger, is a great part articulated with the Sixth Bone of the Wrist.

The Sixth Bone of the *Carpus* is conjoyned to Two Bones of the *Metacarpium*, *viz.* To that which adjoyneth to the First, and obscurely to the middle Finger, and the two other Bones of the *Metacarpium* (which support the Third and Fourth Finger) are coarticulated with the Eighth Bone in shallow Cavities; and this Bone is connected in Two Bones of the *Metacarpium*, to that which is near the First Finger, and obscurely to that Bone which adjoyneth to the middle Finger; and the Sixth Bone of the *Carpus* is also connected to Three Bones, and receives the First Bone into its *Sinus*, and farther insinuates its Head into the *Sinus* of the Fifth Bone, and is superficially articulated with the Fifth Bone.

The Connexion of the Sixth Bone of the Wrist with Two of the *Metacarpium*.

The Seventh Bone of the *Carpus* is endued with a large Head, which is admitted into a *Sinus* common to the First and Second Bone; and in its inside, is conjoyned to the Sixth Bone, and in its outside to the Eighth, in a broad articulation made with a flattish Head, and a shallow *Sinus*; and this articulation is strengthened in some part, by the interposition of a cartilaginous Ligament, which though it strongly ties the Seventh to the Eighth Bone, yet is more commonly luxated inwardly, then any other Bone of the *Carpus*; which is occasioned, by reason of its greatness, and cannot so strongly oppose outward assaults, as the neighbouring Bones, which have their Heads entering into more deep *Sinus*, and by reason the Ligament (tying in the inside the Seventh to the neighbouring Bones) is not so thick and strong as those of the other Bones of the Wrist, which is wisely instituted by Nature, lest the over thickness of the said Ligament, should hinder the passage of the many Tendons of Muscles, called Flexors, coming from the inside of the Cubite, and this Bone is conjoyned to Four Bones of the Wrist, to the Second, Sixth, Eighth, and to the Bone adjoyning to the middle Finger.

The Seventh Bone of the Wrist is articulated with the First, Second, Sixth, and Eighth Bone.

The Eighth Bone of the *Carpus* (as *Vesalius* hath well observed) insinuates it self after the manner of a Wedge, between the Seventh and Third Bone, to both which the Eighth is conjoyned, and is articulated with two Bones of the *Metacarpium*, which adjoyn to the Third and Fourth Finger; and the Eighth Bone hath a peculiar Process in its inside (where it looks toward the palme of the Hand) inclining from the outside of the Eighth Bone inwardly, and engraven in the inside, after the manner of a C, so that it makes a fit seat for the Tendons of the Flexors of the joynts of the Fingers, and out of the joints of the Muscles of the Eighth and Fifth Bone of the *Carpus*, a strong Ligament is propagated, which being transversly encircled with Tendons, keep them that they cannot start out of their proper places. This seat of the Tendons of Muscles is rendred hollow, and though lined with Ligaments, yet is smooth, as well as the other *Sinus*, through which the Tendons are conveyed, as through Rings; and when these Ligaments are pulled out of the *Sinus*, and the Bones freed from them, they are found endued with Asperities, that the Ligaments might be more strong, and more firmly affixed to the Bones, that the Bones of the *Carpus* and *Metacarpium* might be more firmly conjoyned to each other.

The Eighth Bone of the Wrist is conjoyned to the Second, and Third, Bones, and to Two Bones of the *Metacarpium*.

That part of the Bone (relating to the Hand) which is extended from the *Carpus* to the extremities of the Fingers, is called by the *Greeks* and by *Celsus*, *Palma*, aut *Vita Manus* by others.

† Tab. 7. F. 1.
H. H.
The Metacarpium is made up of Four Bones.

The *Metacarpium* (according to *Galen*) is composed of Four Bones †, and of Five, according to *Celsus*, and are longer then the other Bones of the Fingers, and for the most part round, and the longest Bone and most thick, adjoyneth to the Bone of the First Finger, and so they grow less and shorter, as they come toward the little Finger, which hath a Bone of the *Metacarpium*, least in dimensions, adjoyning to it.

The Bones of the Metacarpium do support the contiguous Bones of the Fingers.

The Bones of the *Metacarpium* agreeing in number with those of the Fingers (to which they are adjacent) do support them with their neighbourhood, and are made Concave within, for the reception of Marrow, and to render them light, and more fit for motion, without trouble to the Hand, which their weight would give, were they not inwardly made Concave; and are accommodated both above and below with Appendices, or Protuberancies (of which the Superior are not turned into Bone in a *Fœtus* in the First Month) conjoynd to the Bones of the *Carpus*. The Bones of the *Metacarpium* are somewhat broader in the outside, then they are in the inferior region; and have their upper Surface Convexe, and their lower Concave; and their Appendices touch each other in their sides, and are mutually conjoynd by the interposition of a Cartilaginons Ligament. The inferior Appendices are united to the Bones of the Fingers by a manifest Connection; They are very great, and inclining from the outside of the Head toward the inside, do terminate into oblong round heads, which being lined with a gristle, do enter into the *Sinus* of the First Bones of the Fingers; the inferior Appendices of the Bones of the *Metacarpium*, are not so nearly conjoynd (as the superior) and are somewhat hollowed when they look toward each other, out of which do spring cartilaginous Ligaments; and because these Bones are greater in the upper then lower region, therefore it must be attended with empty spaces, passing between the Bones of the *Metacarpium*, in reference to the lower region, which thereupon becomes fit for the allodgment of Muscles; and the Bone of the *Metacarpium*, adjoyning to the first Finger, is adorned with an Appendix, into which, a Muscle moving the Wrist, is inserted; and the Bone of the *Metacarpe* (adjacent to the little Finger, when it is conjoynd to the Wrist) is somewhat protuberant, that it might receive the insertion of the Tendon of a Muscle, belonging to the Wrist, and the Bones are beset with Asperities, to give admission to the insertions of the Tendons of Muscles.

The number of the Bones of the Fingers.

The Bones of the Fingers are Fifteen in number, as every one is made up of Three, which are set in an elegant order, as composed of several ranks, which are pleasant to behold.

The use of the Hand.

They are framed of Three ranks of Bones, that the Hand might be drawn into greater variety of Figures and Postures, more or less contracting the *Palme* to lay hold upon greater or less things; and if our Fingers were beset with more ranks, then Nature hath wisely instituted, they would much weaken the grasping of Objects, and render the motion of the Hand less nimble, as being burdened with a superfluous number of Finger-bones.

The Bones of the Fingers have various shapes and sizes.

And the use of the Hand doth most clearly appear in Dissection, that the Bones of the Fingers are not endued with the same shape and size, but of great variety of Bones, and they are the most part round, when covered with Muscles and Skin (only they are somewhat depressed in the upper and lower region) lest they should be rendred more liable to outward violations, and

and not so fit to graspe any thing within the Hand, if they were perfectly round; whereupon the Fingers, as being perfectly a round body, should only touch an object in *puncto*, and so not perfectly and strongly contain it within the inward circumference or Palme of the Hand; and four of the Fingers being placed in one order, have one Finger opposite to them, called *Proximum*, aut *ἀντίς* by the *Greeks*, or *Pollex* by the *Latines*, a *Pollendo*, because it is the most strong Finger, and able to ballance all the rest in strength: And as the Fingers are less in Longitude, Magnitude, and ability, so their offices do vary, and the first Bone of the Finger is most large, as the Base and Fulcrum of the rest, and they grow less and less toward their termination, that they may easily close with an object in Flexion.

The Bones of the Fingers are not perfectly round. The Thumb answereth all the four Fingers, as opposite to the most strong.

The first Bone of the Fingers is the most large, as the Base of the rest.

The region of the fifth Bone of the *Carpus*, is incrufted with a Cartilage.

The region of the First Bone of the *Carpus* (made for the first joynt of the Thumb) is incrufted with a smooth and slippery Cartilage, and is prominent transversely, endued with a large oblong protuberance; and the First Bone of the Thumb is engraven with a great and oblong *Sinus*, to give a reception to the head of the Fifth Bone of the Wrist, and is exuberant forward and backward, but chiefly forward, as most agreeable to the mutual ingress of the Fifth Bone of the Wrist, with the First of the Thumb, to constitute its first Joynt, which is not acted with one single, but various motions; and although it is most eminent for lateral motions, whereby the Thumb is brought toward the first Finger, and from it again by abduction; and moreover, this joynt of the Thumb doth admit Flexion or Extension, as it is carried inward toward the Palme, or outward toward the back of the Hand.

The first Bone of the Thumb is inarticulated with the Second, as its lower region doth terminate into one head, insinuating into one *Sinus*; and this head is not perfectly round, and is not altogether orbicularly depressed, and is protuberant in its lower part, and most of all in its sides; and its protuberance is propagated toward its inside, where it is afterward somewhat depressed, and covered with a Cartilage, that the Second Bone of the Thumb might move more softly and safely in its various motions of Flexion, Extension, Abduction and Adduction.

The articulation of the first Bone of the Thumb.

The third joynt of the Thumb, is very much different from the structure of the First and Second, by reason the lower part of the Second Bone, is divided into Two oblong heads (bearing from the outward to the lower region) endued with an orbicular Figure. These heads are parted by an oblong *Sinus*, and covered in some part with a Cartilage, more relating to the inside, then outward region.

The third Bone of the Joynt of the Thumb is different from the structure of the first and second.

The superior region of the Third Bone is engraven into two *Sinus* (separated by an oblong Protuberance, arising between them) receiving two heads of the Second Bone; and the Protuberance of the third Bone enters into a *Sinus*, made in the middle of the head of the Second Bone; and upon this account, the Protuberances of the second Bone enter into the sockets of the third: and the third also insinuates its Prominence into a Cavity of the Second, and both the Bones have such an articulation in a mutual ingress, that the joynt is only capable of Flexion and Extension, and not of a lateral motion; and after this manner of articulation the second and third joynts of the Thumb are framed, and make an acute Flexion, and a straight Extension, without any lateral motion.

The upper region of the third Bone of the Thumb hath two *Sinus*.

The first joynt belonging to each Finger, consists in one Head and one *Sinus* in various Bones receiving, and being received by each other; And every Bone of the *Metacarpium*, doth determinate into one Head, being long

The first joynt of each Finger, consists in one Head, and one *Sinus*.

long in the Inside, then broader, as taken transversely from one side to the other, by reason the Head belongs more to the inside, and is incrustated a greater space with a Cartilage. And the *Sinus* engraven in the upper region in the first Bone relating to every Finger, is endued with an orbicular Figure, and the first Bone upon this Head, doth celebrate the various motions of Flexion, and Extension, and Adduction, and Abduction. And the lateral motions and extensions are not so eminent, by reason they do not make such acute Angles, as Flexion, because the head of the Bones of the *Metacarpium*, is but a little depressed; both outwardly and laterally.

The first Joynt of the Fingers is more extended then the second and third, and is capable of lateral motion, as having a laxer Articulation.

And by reason the head of the first Bone of the Fingers is externally more covered with a Cartilage, then the heads of the second and third Joynts; therefore the first Joynt is more extended then the rest beyond a right line.

The second and third Joynts of the Fingers can only be bent and extended.

Farthermore, the first Finger doth incline more inward in motion, and the little one more outward then the rest of the Fingers, because the heads relating to the Bones of the first Joynts of those Fingers, are more easily carried to the said sides, and moved somewhat orbicularly; And by reason we can move the first Joynts of our Fingers laterally, a laxer Articulation is ordered by nature, which is not requisite in the second and third Joynt, which cannot move laterally, and are only capable of Flexion and Extension, as the most useful motions in the conduct of our Life, in order to take things into our hands, and hold them by Flexion, and let them go again by Extension of our Fingers.

The third Bone of the Fingers is protuberant in its lower region, and hath a rough Head, and two crooked Processes.

The third Bone of the Finger in its lower region (where it is conjoined to no Bone) is protuberant, and is endued with a rough head, and with two crooked Processes, that the Tendons of the Flexors might be propagated out of the lower part of the third Bone, which is inserted in its termination into the apex of the Bone, which becomes Cartilaginous, that the Tendon might be the more firmly implanted into it: And by reason of this Tendon, the third Bone in his inside (where it is somewhat protuberant) is rendred rough and uneven.

The Bones of the Fingers called *Sesamina*, from their smallness, in which they resemble the Seeds of *Sesami*.

Learned and curious *Vesalius*, beside the common Bones of the Fingers, made a discovery of some other small Bones in the Hands and Feet, (not exceeding the dimensions of Sesame, or Fanugreek-seed) which are chiefly found among the Tendons. As the renowned Author hath it, *De lib. Hum. Fabrica. Lib. primo. pag. 91. Ait ille præter ossa tribus jam proxime præcedentibus capitibus explicata, alia quædam exigua in manu occurrunt, sesami semini a dissectionum peritis comparata. Cujusmodi tamen ea sint, & quibus sedibus, quoque numero in homine, aut etiam simia reponantur, neminem observasse, descripsisse ve scio, atq; adhuc minus illorum officulorum usus a quoquam exacte verèq; est pertractatus, oportune igitur quot hujus generis officula diligenti musculorum tendinumq; examine hæcenus invenerim, hic persequor. Musculorum namq; magis quam ossium inspectione, presentium officulorum non pœnitendum numerum, tam in pede, quam in manu comperi: Cum scilicet maxima ex parte, ac tota fere, tendinibus innascentur, unaque tantum superficie, levi & lubrica Cartilagine incrustata, alterius cujusdam ossis lubricam levemq; sedem, contingant, peculiaribus ligamentis illi ossi nusquam commissa.*

The Sesamine Bones are lodged among the Tendons of Muscles.

All these small Bones are lodged among the Tendons, that by reason of their hardness, they might receive and sustain the force of the Bone (in some motions) to, and by which the Tendon is conjoined, and enlarged. And these Bones are chiefly found in old persons, and in Children are of a Cartilaginous nature, and are not very conspicuous in their Tendons, and are commonly found in Dogs, Apes, and other Brutes, who are endued with more

more dry Constitution than Man; in whom, when he cometh to mature age (saith *Vesalius*) he hath two Bones (not far from the second joynt of the Thumb) adjoyning to the head of the first Bone, where it is received into the *Sinus* of the second, and are bred among the Tendons of Muscles, which taking their rise from the Palme of the Hand, do bend the second joynt of the Thumb.

And these small bones are not only seen about the second joynt of the Thumb, but also about the first joynt of the four Fingers, which are less then those of the Thumb, and seated among the Tendons of the Muscles, which having their Origens from the Bones of the *Metacarpium*, do bend the first joynts of the four Fingers; and another soft Bone, and almost Cartilaginous, is found about the Third and Fourth Joynts of the Fingers; and in very old Men, other very small Bones are found in Tendons about all the joynts of the Thumb and Fingers.

These small Bones are lodged about the Joynts of the Thumb and Fingers.

The ranks of Bones in the *Carpus*, and *Metacarpium*, seem in the second Month of a *Fœtus* not to be one Cartilage, and to be parted into five Grilles, as the Origens of Fingers) in whose extremities some white points may be discovered, the first steps of ossification.

The Origens of the Bones belonging to the *Carpus* and *Metacarpium* in a *Fœtus*.

In the Seventh and Eighth Months of a *Fœtus*, the Cartilages of the *Carpus* and *Metacarpium* are somewhat obscure, and are most conspicuous in the Ninth Month, in which they are plainly distinguished; as also in the Cartilages of the Fingers, the rudiments of Bones.

The rudiments of the Bones of the Fingers.

CHAP. LXXXII.

Of the Clavicle, Sternon, and Ribs.

† T. 72. F. 2.
B. B.

THE Clavicles †, are called *Claviculae* by the *Latines*, *Quod instar Clavis scapulam cum sterno claudant & firment*, as Learned *Diemerbroeck* will have it, and *Κλαίdes* by the *Greeks*, because they are conceived to shut up the *Thorax*.

The connexion of the Clavicles.

The Clavicles are articulated with the *Sinus* of the Process of the *Scapula* and with the third Bone of the *Sternon*.

† F. 2. b.
The head of the Clavicle is triangular.

They have their Connexion in one extremity with a Process of the *Scapula*, and in the other with the first Bone of the *Sternon*, As the Heads seated, on the extremities of the *Scapula*, are inarticulated with the *Sinus* of the Process of the *Scapula*, and with the first Bone of the *Sternon*, in which the *Sinus* are oblong, and go from its Anterior downward towards the Posterior part of the Bone, where the *Sinus* are broader then in the hinder region, and are discernable to be higher in the inside, then outside, and the heads of the Clavicles are so framed, that they may comply with the Figure and Situation of the *Sinus*.

The head of the Clavicle (inarticulated with the *Sternon* †) is composed of diverse Angles; whereupon it seemeth somewhat to resemble a Triangle, of which one Angle being obtuse, is seated in the forepart of its head, inclining somewhat to the hinder; The second Angle being also obtuse, is placed in the upper region of the Head of the Clavicle, bending a little toward the Posterior. The third Angle is more acute, and long, and may be discovered in the lower part of the Head, and tendeth downward; and as most of the Angles of the head of the Clavicle (inarticulated with the Bone of the *Sternon*) are obtuse; so also are the sides of the Triangle unequal, and run in bevil lines outward; and the Line drawn from the first Angle to the second is the shortest; and the other drawn from the Second to the Third Angle, much exceeds the first Line in dimensions. And the third Line passing between the first and third Angle, is the longest of all, and the most crooked.

The head of the Clavicle is encompassed with a Cartilage.

The Cartilage of the Clavicle is endued with an unctuous Matter.

The part of the Clavicle adjoining to the *Sternon*, is more spongy then the other.

This head of the Clavicle is in a great part encircled with a Cartilage, whereby it is rendred (answering the greatness of the *Sinus* of the bones of the *Sternon*) smooth, and fit for motion, by reason, if the gristle be parted from the head of the Bone, (relating to the Clavicle) it appeareth rough and unequal. This Cartilage, passing between the head of the Clavicle, and the *Sinus* and *Sternon*, is very thin, and of equal dimensions in all parts in point of thickness, which is very small; and this Gristle is bedewed with an unctuous Matter, to render the head of the Bone and *Sinus* moist and slippery, and the Joynt more easy in motion, which is bound about with Ligaments, orbicularly embracing it, and keeping the head of the Clavicle firm in the *Sinus* of the *Sternon*.

And that of the Clavicle which adjoyneth to the *Sternon* and *Scapula*, is somewhat more spongy and fistulous, then the other seated in the middle, which is endued with a more hard and solid Compage, and is protuberant in each extremity, where it is beautified with Heads, conjoynd by Ligaments to *Sinus*, engraven in the Process of the *Scapula*, and first Bone of the *Sternon*.

As

As to the Figure of the Clavicle it is very various, as endued in some part with a Convex, in others with a Concave Figure, winding in several postures, which is very wonderful; and as it comes from the first Bone of the Sternon (with which it is articulated) it is rendred by nature crooked outwardly, and dressed in its forepart with a Convex, and in its hinder with a Concave Surface; and the Clavicle is rendred Prominent in its fore-part, approaching the Process of the Scapula, where it is after a double manner Convex, and Concave in different parts, adjoyning to each other.

The Figure of the Clavicles.

The Clavicles are made crooked, and endued with various Convex and Concave Surfaces, for the better originations and insertions of Muscles; and they are also rendred inwardly Concave, to give way to the Arteries, Veins, and Gullet.

And the Clavicles are articulated with the Process of the Scapula † to support it in the various motions of the Arm, lest the Scapula coming too much forward toward the Thorax, should hinder the free play of its elevation, Depression, Adduction, and Abduction; whereupon nature hath kept the Scapula from the Ribs, by the help of the Clavicle, as conjoynd to the Process of the Scapula, sprouting out of it at some distance from the Sinus.

The Articulation of the Clavicles with the Scapula.
† T. 72. F. 23. C.

And it is most wisely ordered by the great contrivance of the Omnipotent Architect (whom we ought for ever to admire and adore) that the Clavicles come sooner to maturity than any Bones of the Body, and may be truly called *Offa πρωτογενεα*, as being first Membranous and Cartilaginous, become bony in six weeks, or thereabouts, from the first Conception, and are then conjoynd to the Process of the Scapula in one extremity, and in the other to the first Bone of the Sternon, by reason the Scapula and Sternon are at first of a Membranous or Cartilaginous Nature, so that they want the support of the Clavicles, to keep the Scapula from compressing the Heart, when the Thorax is soft and tender, as circumscribed only with the Ribs and Sternon endued with a Membranous or Cartilaginous substance.

The Clavicles come soon to maturity.

Having Treated of the Clavicles (of which one Extremity is articulated with the first Bone of the Sternon) my design at this time is to speak of the adjacent Bones of the Sternon, which are a Compage of many Bones conjoynd to the Anterior part, or extremities of the Ribs, by the interposition of Cartilages.

The Sternon is seated between the terminations of the Ribs in the Anterior region of the Thorax, to guard the noble householdstuff of the Viscera, the Heart, and Lungs, as with a Buckler, to which the Cartilaginous part of the true Ribs are affixed.

The seat of the Sternon.

This Bone, or rather composition of Bones is endued with a fungous substance, less White than the other Bones of the Body, and is grisly in Infants, except in the upper part of it, which is bony, where it is articulated with the Clavicles, to give a greater strength to their Articulation.

This Compage is made in Children of Six, and seldom or never of Seven or Eight Bones, conjoynd to the Ribs by Cartilages, of which the lowest is the sword-like Cartilage. These Bones, after Eight or Ten Months, being accomplished in Children, do coalesce into fewer Bones, *per Syncondrosim*; that in persons of mature age only, Three or Four Bones can be discerned in the Sternon (distinguished by transverse Sinus) which sometimes becomes one in old age.

The Bones of the Sternon in Children.

The First Bone of the Sternon exceeds the other in dimensions of largeness and thickness; in its upper and middle part it is hollowed with semilunary Trench, styled the *Jugulum* by some; on each side of this Bone is engraven

The first Bone of the Sternon.

engraven a *Sinus* to give a reception to the heads of the Clavicles, to which they are conjoynd by the interposition of Cartilages; and also in the inner region of this Bone a *Sinus* is formed to give a more free passage to the *Aspera Arteria*.

The Second
Bone of the
Sternon.

The Second Bone of the *Sternon* is united to the First (by the mediation of a Gristle) and is endued with more slenderness and length then the highest, and in each side is engraven with Five or Six *Sinus* (seated at unequal spaces from each other) into which the Cartilages of the Ribs are entertained.

The Third
Bone of the
Sternon.
The Ensisiform
Cartilage.

The Third Bone of the *Sternon* is the last, in order, and the least in bulk, and terminates into a Cartilage, which is styled by the *Latines* *Cartilago Ensisiformis*, by the *Greeks* *ἑρποειδής*, which is oblong, and endued with a Triangular Figure, and is for the most part one entire substance, and rarely divided into two portions, between which the Blood-vessels are transmitted; And Learned *Diemerbroeck* saith, it is sometimes adorned with a round Figure, perforated to give a free passage to the mammary Artery, and Vein, which renowned *Riolan* saith is more often in Women.

The ill Fi-
gure of the
Ensisiform Car-
tilage.

Most commonly it is rendred crooked outwardly, and sometimes inwardly, to the great prejudice of the Ventricle and neighbouring parts, in reference to Convulsive motions of the Stomach, and an Atrophy, difficulty of breathing, as hindring the free play of the Midriff, when the carnosus *Fibres* endeavour to bring it to a Plain in Respiration. Sometimes this Gristle is turned into a Bone in old Men, which giveth a great check to the freedom of breathing, and is incurable, as not being capable to be removed by the power of Art. *Westlingius* observed this Cartilage to equal a Finger in length, extended to the Navil, which highly discomposed the Body in Flexion, and disturbed the coction of Aliment in the Stomach, and distribution of the Chyle through the Intestines into the milky vessels of the Mesentery, which was done by the compression of the Stomach and Intestines.

The Ensisiform
Cartilage is
immoveable.

Folius assigneth two Muscles to the elevation and depression of the Cartilage, which are not mentioned by any other Author; and I conceive this Cartilage is immoveable, except it be in persons labouring with a vehement *Astma*, wherein I saw in Mr. *Edling* an Apothecary, the *Sternon* to be lifted up in Inspiration, and depressed in Expiration; so that in this person the ensiform Cartilage, was moved up and down with the other bones of the *Sternon*.

The Cavity
of the Ensi-
form Carti-
lage.

Outwardly in this Cartilage may be felt a Cavity, called by the *Greeks* *κασις*, and by the *Latines*, *Fovea*, or *Scorbiculum cordis*, it being vulgarly apprehended to adjoyn to the Cone of the Heart (which in truth inclineth toward the Left Pap) seated at some distance from it.

The Origin
of the *Sternon*.

As to the Origin of the *Sternon* of a *Fœtus*, it seemeth to sport it self in various Bones, and in the Third or Fourth Month, it is wholly Membranous or Cartilaginous.

Some Anatomists do hold about the Fifth or Sixth Months, the *Sternon* is rendred bony, and is made (up as *Fallopins*, and *Bartholine* will have it) of Eight Bones; but Learned and Curious *Kerckringius* hath observed in many Dissections of *Fœtus*, that in the Fifth Month he found only Two, in the Sixth sometimes Four or Five; and another time only One; and the Eighth Month sometimes he hath found Six, and other times Three, Four, or Five; and Nature in this ossification of the *Sternon*, useth greater freedom, as being tied up to no certain method in it, and sometimes beginneth its ossification in the beginning, or middle, and sometimes in the sides of the *Sternon*, and

and sometimes it maketh a perpendicular line, and other times a line parallel to an Horizontal.

The *Thorax* (being the middle Apartment of the curious Fabrick, relating to Mans Body) is strengthened behind with a Column, consisting in Twelve vertebres of the Back, beautified with the fine carved work of various Processes.

The various Bones encircling the *Thorax*.

This fine middle story is also guarded before with the Bones of the *Sternon*, as with a Breast-plate, and on each side is encircled with Twelve Ribs, as so many strong bony Arches, made inwardly Concave, to render the *Thorax* capable to receive the noble *Supellex* of the Heart and Lungs, the one being a curious Machine to make good the motion of the Blood; and the other is an Organ of Air (consisting in many Pipes and Vesicles) to refine and exalt the vital Liquor by its nitrous and elastick Particles.

The Ribs are Twelve in number (encompassing each side of the *Thorax*) and are seldom Eleven, but sometimes Thirteen, attended with so many Vertebres, instituted by Nature in some part for the articulation of the Ribs, endued with a semi-circular Figure, to make the middle story more spacious for the reception and free play of the *Viscera*, in point of motion.

The number of the Ribs.

The Ribs are endued with various length and magnitude; the First and Second are the shortest, and have the most short Cartilages, appendant to them, and the Sixth Seventh and Eighth exceed them not in length, and are adorned with the most long Cartilages; and the shortness of the First, Second, and Third Rib is compensated with another dimension of largeness; and their Cartilages in like manner answer them in greatness. And the Cartilages (relating to the six upper Ribs) are framed with spaces passing between them, and æquidistant from each other. but the Seventh, Eighth, and Ninth Ribs do closely joyn to each other, without interstices, filling up the intervals (found in the upper Ribs) with their substance; and the Cartilages of the bastard Ribs do terminate into an acute Bone; and the true Ribs have more large extremities: The Cartilage of the first Rib is somewhat broader in its termination, where it is conjoyned to the *Sternon*, and the Cartilages of the Second, Third, Fourth, Fifth, and Sixth Rib, are made somewhat more narrow in their progress, and terminate into Heads, articulated with the *Sternon*.

† T. 72. F. 3. B B B.

The larger Ribs have the most long Cartilages.

The Cartilages of the upper Ribs have interstices. the other Ribs have no spaces.

The Ribs are not adorned with the same smoothness and evenness in all parts; in their inner region, where they look toward the *Pleura*, they are beautified with a smooth surface; but the Third and the following Ribs to the Tenth have a *Sinus*, engraven in them (adjoyning to the vertebres of the Back) formed for the reception of the Blood-vessels in their passage down the Ribs; and these *Sinus* (ordained for the entertainment of the intercostal Nerves, as well as Sanguiducts) render the lower part of the Ribs more thin and slender then the upper.

The various Surfaces of the Ribs.

The outward and convexe Surface of the Ribs, is not every where smooth, by reason in that part (where the Ribs are conjoyned to the Vertebres of the Back) they are framed into Heads, whereby they are articulated with the *Sinus*, relating to the Spondyles of the Chine, where they are also made rough and uneven, as fit places out of, and into which Ligaments are propagated and implanted, tying the Ribs to the Bodies and transverse Processes of the Vertebres. Farthermore, in the outward region of the Ribs, where they part from the transverse Processes of the Spondyles, they are endued with little rough Protuberances, made for the Tendons of Muscles,

The outward region of the Ribs is endued with Protuberances.

which are implanted into the tops of the transverse Processes, and into the Protuberances of the Ribs.

The Asperity
of the Ribs.

And the Ribs at a greater distance from the transverse Processes of the Vertebrae, have some Asperities in the outward Region, made by nature for the insertions of Muscles moving the *Thorax*; and out of these very small Protuberancies, the outward intercostal Muscles take their rise, which do not reach only from the lower region of the upper Rib to the higher part of the lower, but also these intercostal Muscles are extended from the outside of one Rib to the outside of the other; and the other parts of the Ribs are smooth and even, except where the intercostal Muscles borrow their Origin, and into which they are inserted.

The division
of the Ribs.
Their articu-
lation with
the Sternon,
by Cartilages.

The Ribs are divided into true, and spurious, of which the first are conjoyned to the Bones of the *Sternon* by the interposition of cartilaginous productions, and they are the Seven upper Ribs, of which the two first are called *ἀνισοφαί, retortæ*, the two next have the appellative of *σπεραι, solidæ*, the three other are styled *σπεινδε, pectorales*.

The Spurious
Ribs.

The lower Ribs are named Spurious, of which the Four first, with their Cartilages reflected upward, and mutually cohering, are conjoyned in their lower region to the Cartilages of the upper Ribs, and the last Cartilage which is the least, is sometimes affixed to the Diaphragme, and sometimes to the Right Muscle. These Ribs have the appellative of Bastard, as seeming to be imperfect, by reason they are not affixed to the *Sternon* (as the upper Ribs) by the mediation of Cartilages.

The different
substance of
the Ribs.

The Ribs are not composed of one entire similar substance, because part of their Compage is bony, and the other cartilaginous.

The bony substance of the Ribs is not every where alike, by reason where they are conjoyned to the *Sinus* of the Spondyle (constituting the Back) they have a more solid and compact substance then in the sides of the *Thorax*, and the *Sternon* seated in its anterior part, (in which the compage of the Ribs is spungy) is encircled with a kind of Scale or Flake, and is most thin, when it degenerates into a grille, not endued with one uniforme substance, which is most soft in the lower Ribs; whereupon some have called the bastard Ribs *ἡμισπείν, quasi Cartilagines*; and the Cartilages of the upper have more solid substance then the other, and become bony in old persons; and in Sheep and Bullocks are ossified in a middle age; in these Animals some part of the Ribs are covered without and within with a cartilaginous friable bony substance.

The double
Joynt of the
nine upper
Ribs.
The three
lower Ribs
have but one
Joynt.

The Ribs are not endued with one kind of Articulation, by reason the Nine upper ones are conjoyned by a double joynt, to give them the greater strength, and the Tenth, Eleventh, and Twelfth are articulated with one Joynt; and the Ribs conjoyned by a double Joynt, are adorned with a double head, of which one insinuateth it self into the *Sinus*, relating to the body of the Verteber; and the other head climbeth up the transverse Process of the same Verteber, till it hath arrived its *Sinus*, to which it is conjoyned in the side of the *Apex* of the said Process.

The articula-
tion of the
First Rib.

The First Rib is articulated with a round Head, entring into a *Sinus*, engraven in the body of the first Verteber of the Back, and afterward the Rib ascends to the transverse Process of the Verteber, till the Rib makes an entrance with another head into a *Sinus*, hollowed in the *Apex* of the said Process; So *Vesalius*: But Learned Dr. *Mayo* conceiveth, that a Protuberance of the Spine enters into a *Sinus* of the Rib, in this Second articulation of the Rib with the Chine.

The

The Second and the Seven following Ribs, are articulated, not with round, but with heads protuberating into obtuse Angles, entering into the *Sinus*, common to the bodies of two Vertebres, and have the other heads articulated with transverse Processes, after the same manner of the first Rib, with this difference, that the transverse Processes of the upper Vertebres have their *Sinus* engraven into the lower part of their inward region; but the transverse Processes of the lower Vertebres have their *Sinus* hollowed into the upper part of the inner region (as Learned *Vesalius* hath well observed) and the *Sinus* belonging to the bodies of the middle Vertebres, are articulated after a middle manner.

The use of this Articulation of the Ribs with the Spine (I humbly conceive may be this) That the conjunction of them being made in a double Joynt, is to assist Respiration in the dilatation of the *Thorax*, for the reception of the expanded Lungs, by reason the double joynts are so obliquely seated, and contrived with such Artifice, that the Ribs by often contraction of the intercostal Muscles, are not only moved upward, but outward too; whereupon the Ribs being carried upward and outward, must necessarily enlarge the capacity of the *Thorax*, to make way for the Lungs, puffed up with the elastick Particles of Air; so that it is very evident, that the Ribs being drawn upward and outward, do give greater dimensions to the middle Apartment, and when they are pulled downward and inward, they narrow the Cavity of the *Thorax*, so that we may see in any Skeleton, that the Ribs (especially the lower, which are most conducive to the dilatation of the Breast) are articulated with the Spine and *Sternon*, not according to right lines; whereupon the Ribs, when they are elevated and carried outward, do come near to Right Angles, and the *Thorax* is dilated in breadth, and enlarged in length, as the Diaphragme is brought from an Arch to a Plane.

The use of the articulation of the Ribs.

But the upper Ribs in their anterior parts are connected to the *Sternon*, by the interposition of Cartilages, among which, the Cartilages of the Second Rib, being protuberant, after the manner of an obtuse Triangle, are received into a *Sinus* of the *Sternon* by a laxe Articulation; and beside this *Sinus*, the *Sternon* on each side hath many Cavities formed, somewhat after the manner of obtuse Angles, which are not æquidistant from each other, by reason the *Sinus* of the *Sternon*, engraven for the Cartilage of the third Rib, hath a greater distance from the *Sinus* of the Second Rib, then the *Sinus* (made for the Fourth) is removed from the *Sinus*, receiving the Cartilage of the Third Rib. And again, a greater space is found between the Second and Third, then between the Third and Fourth *Sinus* of the *Sternon*. And the *Sinus* of the *Sternon* made for the reception of the Cartilages of the First and Seventh Rib, do so nearly adjoin, that they touch each other, and are not so deeply hollowed as the *Sinus* of the *Sternon*, relating to the Cartilages of the other Ribs.

The connexion of the Ribs to the *Sternon* by the mediation of Cartilages. The Cavities of the *Sternon* made after the manner of obtuse angles.

The fine Compage of the *Sternon* is framed, being Convexe above, and Concave below, to give way to the *Viscera*, as well as the ranks of Ribs, (are made as so many Arches encircling the sides of the *Thorax*) conjoined to the Spine of the Back, wrought into fine carved work, consisting of various Processes, to render the *Thorax* firm and strong, to oppose the assaults of outward accidents.

The *Sinus* of the Sixth and Seventh Ribs are smaller then the rest.

† T. 72. F. 3. D. D.

And the Ribs are consigned to a farther use as they are elevated and drawn outward by the contraction of the intercostal Muscles, to enlarge the dimensions of the *Thorax*, to entertain the expanded Lungs in order to Inspirations; and afterward, when they are carried downward, and inward

The use of the Ribs.

by a kind of recoiling, (as over-extended in Inspiration) to depress the Lungs, and make good Expiration.

The Origen
of the Ribs in
a *Fœtus*.

Having given a History of the Number, Magnitude, Length, Figure, Substance, and Articulation of the Ribs, it may seem now proper to speak somewhat of their Origins in a *Fœtus*, and how from Month to Month, step by step they come to maturity.

In the Second
Month.

In the Second Month the Ribs belonging to a *Fœtus*, have their upper and lower region Cartilaginous, and the other parts Bony; and a *Sinus* may be plainly seen, through which the intercostal Nerves, Arteries and Veins make their progress.

And the Ribs and Clavicles are for the most part very early turned into Bones, that they may guard the Cavity of the Breast, as a safe repository, made for the entertainment of the Lungs and Heart, that they may freely exert their noble operations of Respiration and Pulsation, within the strong walls of the bony Arches, without the least compression.

And in the extremities of the Ribs in the second Month, no Joynts or Articulations of the Ribs appear in the hinder region with the *Chine*, or in the Anterior extremity with the *Sternon*.

The Origins
of the Ribs in
the Third
Month.

In the third Month the upper part of the Ribs is ossified, and the Inferior region hath some footstep of it, and sometimes to the Fourth or Fifth Month remaineth cartilaginous, which is very rare; From the Fourth to the Ninth Month, they are enlarged in dimensions, and have greater degrees of ossification, as the Ribs grow greater and more solid and firm, and their heads (by which they are articulated with the *Chine*) remain cartilaginous to the time of the Birth, without the least degree of Ossification.

The Surface
of the Ribs in
a *Fœtus*.

The Ribs in a *Fœtus* have a Concave Surface, whereby they are made so many Arches, and the Six upper Ribs tend upward in their extremities, and in their middle bend downward; and the Six lower Ribs, contrariwise, have a Convexe Surface in their middle region, and ascend, and in their extremities pass downward.

C H A P.

CHAP. LXXXIII.

Of the Os Innominatum, Thigh-bone, &c.

THE Elegant Frame of Man's Body hath its lowest Apartment seel'd above by the Diaphragm (endued sometimes with an arched, and other times with a more plain Surface) and floored below with a system of strong Bones, before with the Share-bone, and behind with the *Os Sacrum*, and below with the *Coxendix*.

The *Ossa innominata* (so called) as having no appellative in the general, (but their parts are distinguished by proper names) and are connected to the sides of the *Os Sacrum* with a most strong Ligament by the interposition of a Cartilage.

The *Ossa Innominata*.
The Connexion of the *Os Innominatum*.

Each *Os Innominatum* is framed of three Bones, of the *Ilium*, *Coxendix*, and Share-bone, closely conjoyned by Cartilages, which may be separated one from another in Infants by the help of a thin Knife, and their boundaries may be discovered to the Seventh year, and afterward their Cartilages being dried, they are turned into one strong Bone, which being on each side united to the *Os Sacrum* maketh the Cavity, called the *Pelvis*, in which are reposed the Intestines and Bladder, and *Uterus* too in Women.

The Bones of the *Os Innominatum*.

The *Os Ilium* † hath its denomination from the Guts (called *Ilia*) which are supported by this Bone. This is the upper and most large part of the *Os Innominatum*, and its inside being endued with a concave Surface, is called the *Costa*, and hath a semicircular and uneven circumference named *Spina* †, whose Extremities are called *Labra* and *Supercilia*; And the outward region of the whole Bone is called *Dorsum* †; This Bone besides the interposition of a Cartilage, is conjoyned to the *Os Sacrum* by a strong membranous, or rather cartilaginous Ligament.

The *Os Ilium*
† T. 72. F. 7.
A A.

† F. 7. b b b.

† F. 7. C.

The Region of the *Os Ilium*, where it is connected to the *Os Sacrum*, consists of several parts; And the transverse Processes of the *Os Sacrum* (where it is conjoyned to the *Ilium*) are very various; and to each *Sinus* of these Processes, the Protuberances of the *Ilium* are fitted, and on the other side the Prominencies of the Processes of the *Os Sacrum* do agree in dimensions with the *Sinus* of the *Ilium*; So that the *Sinus* and Protuberances of the Processes of the *Os Sacrum*, and *Ilium*, have a mutual Ingress in Connexion, which is not ordained for a voluntary motion as accommodated with smooth *Sinus* and Protuberancies incrusted with slippery Cartilages, but is made by a close union in Articulation, by way of *Symphysis* by the mediation of a strong cartilaginous Ligament; And the *Sinus* and Protuberancies of the Processes of the *Os Sacrum* and *Ilium* do mutually correspond, so that the long Protuberancies of the one do insinuate into the long *Sinus* of the other, and where they are connected they every way agree in fit cavities and prominencies, as Learned *Vesalius* hath curiously observed in *Corpor. Human. Fabrica*, Lib. I. p. 94. *Ait ille, Ut enim transversos ossis sacri processus primum oblongo sinu donari, ita etiam os Ilium oblongum tuberculum congruens obtinet, & quia processus sinus anterior pars, sinusve supercilia, satis insigniter extuberant, porrigunturq; ilium etiam ossi ad anteriorum oblongi sui tuberis sedem, sinus insculpuntur,*

The connexion of the *Os Ilium* with the *Os Sacrum*.

The Protuberances and *Sinus* of the *Os Ilium* and *Sacrum* are mutually fitted.

The connexion of the *Os Ilium* with the *Sacrum*, is made by *Symphysis*.

quos extub. rantes illæ processuum partes subeunt. Ubi enim humillima eorum sinuum sedes conspicitur, Ilium Os quasi in cultri aciem exacuitur, ut eandem cum quarti Ossis sacri transverso processu constituat superficiem. Rursus oblongo Ossis sacri tuberi, quod instar latioris lineæ in processuum sinibus eminere relatum est, oblongus enim Ilium ossis sinus convenit, tuber id ad amussim suscipiens. Porro duobus processuum sinibus ad posteriorem, nunc tuberi sedem consistentibus, tuberi transversim in illorum sinuum medio prominentes Ilium os non æque accuratè respondet, quum sacrum Os Ilium ossi non admodum hac sede conterminum: Sed plurima cartilago Ligamenti naturæ participans, hac ossa intercedat, totam amplitudinem, qua invicem ossa debiscunt, infarciens.

The Os Coxendicis, † T. 2. F. 7. FFF. † F. 7. G G. The Socket of the Os Innominatum receiving the great head of the Thigh-bone.

The connexion of the Thigh-bone with the Os Coxendicis by a double Ligament.

The many little holes of the Coxendix out of which the Ligaments arise.

† T. 7. F. 7. I.

The round Cavity of the Coxendix is enclosed with a slippery Cartilage.

The Supercilia relating to the Sinus of the Ischium.

The Os Coxendicis †, vel Ischium, is the lower and outward part of the Os Innominatum, which is endued with great thickness and solidity, containing in it a large Cavity † or Socket, (in which the Orbicular head of the Thigh-bone is lodged) and if it slip out of the Acetabulum, a Luxation is made, which Nature highly endeavoreth to prevent, as she hath wisely and firmly connected the head of the Thigh-bone with the Sinus of the Ischium by a double Ligament, taking their rise out of the Os Sacrum. And the Cavity of the Ischium is enlarged by a cartilaginous Process (called Supercilium) for the more firm articulation of the Socket of the Coxendix with the head of the Thigh-bone.

In the upper Region of the Os Coxendicis, a large Sinus is engraven, in which (the Bone being cleansed) may be discovered many little holes, out of which springeth a Ligament, by whose aid the Bone is there smooth and slippery (as anointed with Oyl) that at this Sinus some Muscles, belonging to the Thigh-bone, may freely play; At each side of this Sinus a Protuberance is seated, and an eminent Cartilage †, enlarging the Sinus and preventing the descending Muscles lest they should swerve from it. And also a Protuberance is placed at the outside of the Sinus, common to the Bone of the Ilium, and Coxendix, which is rough and uneven for the firmer implantation of Muscles. And the inner Protuberance is very thick and solid to give strength to the Os Coxendicis, and that a deep and large Socket might be engraven in it fit for the reception of the oblong head of the Bone; So that on the outside of the Coxendix (whose strength Nature hath most wisely contrived) a large and most deep round Cavity is engraven, not every where smooth, but incrusted with a slippery Cartilage; And in the anterior Region a small portion is more deeply hollowed (then in the other part of the Circumference) which is rough and beset with holes, formed for the origination of a round strong Ligament, inserted into the top of the head relating to the Thigh-bone.

And the Supercilia of the said Sinus (which in some Children are adorned with an Appendix) are less protuberant in the Anterior then Posterior Region, because the Thigh is more brought by Flexion into an Angle in sitting then standing. Furthermore, In the lower part of Supercilia, appertaining to the Sinus of the Coxendix, it is worthy a remark, that the Supercilia are not carried orbicularly with one continued Duct, but some space is left in them, making way for a small Blood-vessel, taking its progress through a rough part of the Sinus, not covered with a Cartilage.

And lest this Joynt of the Coxendix with the Thigh (supporting oftentimes the weight of the whole Body) should admit a Luxation, and hinder the due exercise of progressive motion, Nature hath encircled the Supercilia of the Sinus with a strong cartilaginous Ligament firmly tying the head of the Thigh-bone to the Sinus of the Coxendix; And Nature hath also framed in

its

its Socket many holes (dressing the outside of the *Supercilia*) out of which a strong Ligament borroweth its rise, and is implanted into the head of the Thigh-bone, whereby it is firmly fastned to the Socket of the *Os Coxæ*.

And the *Os Coxendicis* is also adorned with an acute Process, from whence ariseth a Ligament (belonging to the fifth bone of the *Os Sacrum*) out of which divers Muscles of the Thigh-bone, take their origination. And furthermore a *Sinus* may be observed, engraven in the hinder and external Region of the *Os Coxendicis* under the said acute Process, at which a Muscle of the Thigh is reflected after the manner of a little Wheel belonging to a Pulley. And also a great and thick † Appendix groweth to the lower Region of the *Os Coxendicis*, (on which we partly rest in time of sitting) to give strength to the said Bone, as also an advantage to the origination of many Muscles.

The acute Process of the *Coxendix*, emitteth a Ligament.

The Appendix of *Os Ilium*.
† T. 72. F. 7. K.

The *Os Pubis* †, or *Pectinis*, called by us the Share-bone) is the anterior and thinner part of the *Os Innominatum*, perforated with a large hole † to render it light for the greater ease of the lowest Apartment. The *Pubes* is composed of a double Bone (most visible in Children) conjoyned by the interposition of a Cartilage; And is hollowed above with a *Sinus* to make way for the passage of the Crural Vessels which are not transmitted through the great *Foramen*, filled up with a strong Membrane.

† F. 7 DDD.

† F. 7. E.

The double Bone of the *Os Pubis* in Children conjoyned by a Cartilage.

The upper Region of the *Offa Pubis* (where they are closely conjoyned by an Articulation, called *Symphysis*) is rendered rough, as most fit for the origination of the right Muscles of the *Abdomen*, and the anterior part of the *Os Pubis* is made uneven, for the rise of a Muscle moving the Leg; and about the fore part of this Bone a Prominence may be discovered, coming from the inside of the *Sinus* (belonging to the *Coxendix*) to the Commisfure of the *Os Pubis*, giving an advantage to the rise of a Muscle moving the Thigh.

The *Offa Pubis* are conjoyned by *Symphysis*.

A Prominence of the fore-part of the *Os Pubis*.

And not only the anterior but the posterior Region of the Share-bone is uneven too, as endued with a narrow long roughness, somewhat resembling a Line, made for the implantation of Muscles. Furthermore, the *Os Pubis* is endued with a more then ordinary thickness about the lower Region, where the Bones are united, and about the inside of the great hole, where it is thick and somewhat round, to give strength to the said Bone.

The unevenness of the anterior and posterior region of the *Os Pubis*.

And now it may be worth our time to consider the difference of the *Os Innominatum* and *Os Sacrum* relating to Men and Women, which chiefly consists in these four considerables.

The difference of the *Os Innominatum*, in Men from Women. The first difference.

First, The *Os Sacrum* is much more hollowed outwardly in Women then Men, that a more large and free passage might be given to the *Fætus* in time of the Birth, upon which account the *Os Coxygis* is conjoyned to the *Os Sacrum* by a more loose Articulation.

Secondly, The *Offa Ilium* are larger, and rendred more Concave, and their Spine is more turned outward in Women then Men, to enlarge the dimensions of the *Pelvis* for the more free reception of the *Fætus*.

The second difference.

Thirdly, The lower Region of the *Os Pubis* and *Coxendicis* doth incline more outward in Females then Males, to give a greater latitude to the *Pelvis*.

The third difference.

Fourthly, The Cartilage (by whose mediation the *Offa Pubis* are connected) is much more thick and loose in Women then Men, to give it a power of a more free and greater extension without Laceration upon the birth of the Child.

The fourth difference.

A Question
started;
whether the
Bones of the
*Os Innomina-
tum* and *Sa-
crum* do part
in the birth of
the Child.

A Question may be started, whether the Share-bones do part from each other, and the *Offa Ilium* be severed from the *Os Sacrum* in the birth of the Child? To which this Reply may be made; That a small *Fœtus* may pass through the *Foramen* of the *Offa Pubis* without any trouble or separation of the said Bones, but in a hard Birth, when the *Fœtus* is very large, and the hole of the Share-bone is narrow, the Cartilages and Ligaments being relaxed, the *Offa Pubis* may be disjoyned, and the *Offa Ilium* may be parted from the *Os Sacrum* to enlarge the passage, wherein the *Fœtus* may be safely brought into the World.

The Origen
of the *Os In-
nominatum* in a
Fœtus.

Before I treat of the next Bone, I will take the freedom to give a short History of the Origen of the *Os Innominatum*, which in a *Fœtus* is a Compage of three distinct Bones mutually annexed by the interposition of Cartilages.

The *Os Ilium*
in a *Fœtus* is
encircled with
a cartilagi-
nous Margent,
of a Semilu-
nary figure.

The first having the appellative of the *Os Ilium*, is conjoyned by Cartilages to the Vertebres of the *Os Sacrum*, and climbing upward, is encircled with a cartilaginous Margent, resembling a Half-Moon; and being carried forward, doth make half the *Sinus*, afterward receptive in some part of the Thigh-bone: And the other Bone (called the *Os Pubis*) is seated in the anterior region of the *Os Innominatum*, and conjoyned by a Cartilage to the upper part of the *Sinus*, and is extended with a short and thin body to the cartilaginous Commissure.

The third Bone of the *Os Innominatum* (named the *Os Coxendicis*) doth constitute a great part of the Socket, and descending obliquely with a thick and broad Body, and being accompanied with the Share-bone, and with a Cartilage, doth encompass the *Foramen* relating to the *Pelvis*.

The *Os Innominatum* in the
second Month
of a *Fœtus*.

In the second Month the *Os Innominatum* seemeth to be one confused Cartilage, only in the *Os Ilium* about the *Sinus*, appears an ossified point, not exceeding the head of a Needle.

In the third
Month.

In the third Month the bony point of the *Ilium* is enlarged, and receiveth the form of a more solid Bone, adorned with a Semilunary figure, encircled with a cartilaginous Margent, and the other Bones of the *Pubes* and *Coxendix* remain Cartilaginous, as having not the least footstep of Bones.

In the fourth
Month.

In the fourth Month the *Os Coxendicis* begins to shew its white Head (about the *Sinus*) in small points, equalling in bigness the heads of Needles, and afterward groweth more and more bony.

In the fifth
Month.

In the fifth Month the Share-bone begins its long Compage about the Circle of the *Sinus*, and the *Os Coxendicis* and *Ilium* do much enlarge their bony substance, and obtain their perfect shape, and grow more and more solid to the ninth Month, when they are mutually and loosely connected by cartilaginous interpositions, which do help the globular position of the *Fœtus* in the *Uterus*; and the semicircular Margents of the *Os Ilium* being rendred soft by a cartilaginous figure, do facilitate the birth of the *Fœtus* in reference to its passage through the narrow Confines of the tender Compage, relating to the *Vagina Uteri*.

CHAP. LXXXIV.

Of the Bones of the Thigh, Leg, &c.

THE Foot (being taken according to the Antients in a Comprehensive notion) is constituted of three parts of the Thigh, Leg, and Foot, according to a common and modern acception.

The Thigh is endued only with one Bone †; which excelleth all other Bones of the Body in length, and is adorned in its anterior region with somewhat of a gibbous, and behind with a more depressed and hollow Figure, and with a rough Line, obliquely descending toward the Knee.

And in its upper part (as well as lower) is adorned with an Appendix † beautified with a round Head (set upon a long Neck †) exactly fitted to the Sinus. This Head (by which the Thigh is rendred capable to be bent and extended, and carried inward and outward in lateral motions) is incrusted with a Cartilage, which being soft doth prevent the grating of the head of the Thigh-bone against the Socket of the *Os Coxendicis*, and much contributeth to the more easie motion of the Thigh. And a little below the middle of the top of the head, relating to the Thigh-bone, may be seen a narrow, deep and uneven Sinus, into which a round Ligament is most firmly inserted, borrowing its Origen from the Socket of the *Os Coxendicis*, in which the head of the Thigh-bone is firmly kept by the help of two strong Ligaments, of which one being membranous, broad, and thick, doth encircle the whole Joynt, and the other Ligament being short and round, taketh its rise from the Sinus of the *Os Coxendicis*, and is implanted into the head of the Thigh-bone, and preventeth its Luxation in violent motions of the Body.

This Articulation is made *per Enarthrosin*, wherein the great head of the Thigh-bone (adjoyning to a long Neck) entreth into the deep Socket of the *Os Coxendicis*, for the more firm articulation of this Joynt supporting the weight of the whole Body.

The head of the Thigh-bone is fastned to the Neck of it with somewhat a loose connection, so that after it hath been boiled, it may be severed from the Neck, especially in younger Animals; whereupon in Infants, and young Children, the head of the said Bone is sometimes parted from the Neck, upon some small occasion, as upon a slight fall, or when the Nurfes do put weak Children too soon upon their Feet, and endeavor to make them go, which sometimes maketh a separation of one part of a Bone from another, and is no true Luxation (as some mistake) by reason two distinct articulated Bones are not unnaturally severed from each other.

Below the Neck of the Thigh-bone, (where it begins to be enlarged) two Processes sprout out, which are very visible in Children, and of a cartilaginous nature, and afterward grow bony, and united to the body of the Thigh-bone, so that it appears as if there had been no diversity of substance in the Processes, and the Bone out of which they took their rise.

The superior of these Processes being the greater, climbing upward, inclineth outwardly; the other Process is the inferior and much less then the other, and terminates into a kind of obtuse Cone, and looks backward

The Foot according to the Antients, is composed of three parts.

† T. 72. F. 1. K. K.

The Thigh-bone.

The Surfaces of the Thigh-bone.

† F. 1. d. d.

† F. 1. e. e.

The Appendix of the Thigh-bone.

The head of the Thigh-bone is incrusted with a Cartilage.

A Sinus seated in the middle of the top of the Head relating to the Thigh-bone.

The Ligaments of the Thigh-bone.

The manner of the articulation of the Thigh-bone, is made *per Enarthrosin*.

The articulation of the Thigh is loose.

The Processes of the Thigh-bone.

and inwardly, and this seemeth to be rather an *Apophysis*, then *Epiphysis*.

The *Trochanter Major*.
† T. 72. F. 1.
ff.
† F. 1. g. g.
Many Muscles
take their rise
out of the
Trochanters.

The greater Process is called by the Anatomists *Trochanter*, seu *Rotator Major* †, and the less *Trochanter Minor* †, near which a small Prominence may be found, seated a little beneath the said *Rotator*: From and into these two Processes (called *Trochanters*) many Muscles take their rise, and are inserted, which speak the great use of these Protuberancies; And also this Bone hath many rough Lines and Asperities framed in the outward and inward Region for the origination and implantation of Muscles.

† F. 1. h h h h.
The two
heads of the
inferior region
of the
Thigh-bone.

The inferior region of the Thigh-bone (which exceedeth the upper part in bigness) terminates into two oblong heads †, which are the greatest of the whole Body, and do incline much more toward the posterior then fore-part of the Thigh-bone, and are protuberant in the sides as well as middle; the outward head is greater then the inner, and they are both received into the *Sinus* (engraven into the *Os Tibia*) lined with Cartilages.

The lower
Joyns of the
Thigh-bone is
capable only
of Flexion
and Extension.

These heads are so articulated with the Bone of the *Tibia*, that they are only capable of flexion and extension, and no ways of lateral motions, as Learned *Vesalins* will have it; And upon that account the heads of the Thigh-bone are formed towards its posterior Region, that it might make an Angle in flexion, and not be extended beyond a right Line, in its inclination forward; so that by reason of this motion, the heads of the Thigh-bone are not protuberant in its anterior Region.

The heads of
the Thigh-
bones are
parted by a
considerable
space, in
which is en-
graven a *Sinus*.

The heads of the Thigh-bone are parted from each other by a considerable space into which is engraven a large rough *Sinus* (not covered with a Cartilage) which receiveth an uneven and rough Protuberance (belonging to the *Os Tibia*) arising in the middle of the two *Sinus*; out of the said Protuberance a Ligament borroweth its Origen, and is inserted (being in the company of another strong Ligament, arising out of the hinder region of the *Os Tibia*) into a *Sinus*, lodged between the heads of the Thigh-bone.

The Liga-
ment fastning
the *Os Tibia*
to the Thigh-
bone.

And out of the outside of the Head (relating to the Thigh-bone) a Ligament taketh its rise, which tieth the Thigh-bone and *Os Tibia* together, and the sides appertaining to the heads of the Thigh-bone, are not incrufted with a Cartilage, but beset with many little holes, out of which do sprout many strong Ligaments strengthening the Joynt by a firm connexion of the heads of the Thigh-bone to the *Sinus* of the *Os Tibia*.

† T. 72. F. 1.
M M.
The *Tibia* is
endued with a
kind of trian-
gular figure.

In the *Tibia* as well as in the Cubite two Bones are framed by Nature, of which the inner is most great, and hath the appellative of the whole Limb, and is by the *Greeks* called *κνήμιν*, by the *Latins*, *Tibia* †, and vulgarly *Focile Majus*, and is a very strong large bone, endued after some manner with a triangular figure, and resembleth according to its fore-part (passing in length) an acute Spine in its anterior Angle, where it is void of Flesh, and encircled with the *Periosteum*, *Membrana Carnosa*, and with little or no Fat, interposed between it and the *Cutis*; whereupon the contusion of the anterior part of the Leg giveth a great trouble in its Cure, by reason the *Periosteum* and *Membrana carnosae*, are not guarded with much Flesh or Fat.

The Cavity of
the *Os Tibia*
filled with
marrow.

The *Os Tibia*, as well as other great Bones, is hollowed in its interior recesses (and filled with a fatty oily substance) to render it more light and easie in progressive motion.

The two
oblong *Sinus*
in whose mid-
dle is seated a
Protuberance

In the upper part of this Bone two oblong *Sinus* are engraven (parted from each other by a rough and uneven Protuberance, and incrufted with a slippery Cartilage) into which the heads (placed in the lower region of the Thigh-bone) are received; And the Protuberance, seated between the

two

two *Sinus*, is insinuated into a deep *Sinus*, severing the lower heads of the Thigh-bone; And the said Protuberance of the *Os Tibia* in its upper and middle region (which is rough and hollow) as covered with no Cartilage, doth emit a strong Ligament, implanted into the posterior part of the *Sinus* relating to the Thigh-bone (lodged between its two heads) and in the anterior part of the said Protuberance (which is less prominent) no Ligament is inserted into the Thigh-bone, but Ligaments are there generated which do fasten Cartilages to the anterior region of this Protuberance, and do enlarge the *Sinus* of the *Os Tibia*, by reason the two Sockets of the *Os Tibia* (receiving the heads of the Thigh-bone) being shallow, and not exactly answering the said *Sinus*, Nature hath encreased their Cavities with an admirable Artifice, and beside the slippery Cartilages, covering the *Sinus* of the *Os Tibia*, and the heads of the Thigh-bone, she hath given to each *Sinus* a Cartilage, connecting the Bones of the Joynt by way of Ligaments (which do orbicularly encompass it) being soft Cartilages, and when they are contiguous to the Bones, they are very even, smooth, and slippery, as besmeared with an unctuous Humor; These Cartilages are more thick in the circumference of the Joynt, and more thin about the Center, and are endued with a Semilunary figure, and may be discerned to be greatest in dimensions about the middle, and most small in their extremities, into which they terminate as into Cones, of which they come nearer to each other, which are seated in the anterior part of the protuberance of the *Os Tibia*, where the right Cartilage is affixed to the left; and the Cartilages placed in the posterior region of the said Protuberance, are farther distant, and are not mutually conjoyned, as it is discernible in the anterior Cartilages. And a most thick Ligament coming out of the Protuberance of the *Tibia*, is inserted into the Thigh-bone, severing the points of the latter Cartilages; whereupon it is most evident how these Cartilages do enlarge the *Sinus* of the *Os Tibia*, not only in Men, but in Quadrupeds and Fowl.

A Ligament coming out of a Protuberance of the *Os Tibia*.

The *Sinus* of the *Os Tibia* are enlarged by Cartilages, which by way of Ligaments encompass the Joynt orbicularly.

The Cartilages of the *Sinus Tibia*, are endued with a Semilunary figure.

This Bone hath a fair Appendix placed at each Extremity. The upper one is more large then the other, and also endued with a Protuberance parting the two *Sinus*, which are almost encompassed with a Cartilaginous Margent rendring the Sockets more deep and large for the firm articulation of the Knee: Between these two *Sinus* ariseth a little Hillock (as a partition between the two *Sinus*) out of whose rough and hollowed top a strong Ligament taketh its rise, and is inserted into a *Sinus* of the Thigh-bone (seated between its two heads) which highly strengtheneth this Joynt.

The Appendices of the *Os Tibia*. The upper Appendix.

The inferior Appendix of the *Os Tibia* is much less then the other, endued with a great Protuberance growing on the inside of the said Bone, which is not covered with any Fat or Flesh, and is called *Malleolus internus*, the inner Ankle †, making the round Knob, or Prominence in the inside of the Leg, near the Foot.

The lower Appendix.

† T. 72. F. 1. i. i.

The *Os* (called *Fibula*) doth not reach to the top of the *Tibia*, so that the upper Appendix of the *Fibula*, hath a *Sinus* engraven in its inside, into which a small Protuberance (relating to the Appendix of the *Os Tibia*) is received; and the lower region of the *Fibula* hath a different Articulation (from that above) with the *Os Tibia*, whose outside hath an oblong *Sinus*, into which the Protuberance of the inside of the *Fibula* doth enter: And because the said Bones are mutually conjoyned, a strong Ligament interposeth, not only connecting them in circumference, but also where they are mutually conjoyned.

The *Os Fibula* † T. 71. F. 1. N. N.

A *Sinus* of the *Fibula* into which a small Protuberance of the *Tibia* is received.

A Ligament connecting the *Os Fibula* to the *Tibia*.

And

The *Os Fibula*
and *Tibia* are
disjoyned.

And according to the length of the *Tibia* the *Fibula* is disjoyned from it in its other parts, which are very much smaller then where they are conjoyned, whereupon the Appendices of the *Os Tibia* being thick, must necessarily keep the bodies of the *Os Tibia* and *Fibula* at a distance, as being smaller then their Extremities, and are somewhat nearer each other, where they are straight; and a little below the middle in point of length, the *Fibula* is rendred crooked towards the *Tibia*, and rendred concave in its outside.

The *Os Tibia*
and *Fibula* are
articulated
with the *Talus*.

A double *Sinus*
of the *Os Tibia*
parted
by a Protu-
berance seated
between
them.

The inferior Appendices of the *Os Tibia* and *Fibula*, make a *Sinus* into which the *Falus* with a mutual ingress is articulated, by reason in the lower region of the *Os Tibia* a large *Sinus* is engraven, which seemeth to be double, and about the middle of them is placed a Protuberance severing the said *Sinus* one from another; At the inside of this *Sinus* the lower Appendix of the *Os Tibia* passeth downward with a great Process, which in its outside (looking toward the *Sinus*) is hollow, and is as well as the *Sinus* smooth, and incrusted with a Cartilage, and is prominent in the inside making the inner Ankle; This Process in its lower Region, tending backward, obtains a rough *Sinus*, from which a cartilaginous Ligament taketh its rise, tying the *Os Tibia* to the *Talus*.

The two
Heads of the
Fibula are en-
tertained into
Sinus of the
Os Tibia.

The *Fibula* hath two Heads (one above and the other below) terminating into an acute Process; The upper Head of the *Fibula* doth not climb so high as the Knee, and is entertained into a shallow *Sinus* of the *Os Tibia*: And the lower Head of the *Fibula* is received into a Cavity engraven into the *Os Tibia*, and the *Fibula* sends down a protuberant Head with a Process to the side of the *Talus*, where it is outwardly very conspicuous, and is called the outward Ankle, seated somewhat lower then the inner.

The *Patella*
or Pan-Bone
of the Knee.

† T. 72. F. 1.
L. L.

The hinder
Region of the
Patella is in-
crusted with
a Cartilage,
and hath a
Sinus fitted
to a Head of
the Thigh-
bone.

To the anterior part of the Knee a little round Bone is affixed, (not unlike a little Target) called by the *Greek* *μύλαν*, as somewhat resembling a Millstone in the roundness of its figure, and denominated by the *Latins*, *Patella* †, as being somewhat like a little Dish in its orbicular shape, as the Antients imagined.

In its hinder region (looking toward the Thigh) it is for the most part immured with a smooth and slippery Cartilage, and with a Protuberance and *Sinus*, elegantly fitted to the anterior part of the Heads, relating to the lower region of the Thigh-bone, and according to its length, is adorned with a large Prominence, entring into a *Sinus*, engraven in the anterior part of the Heads, belonging to the Thigh-bone; and on each side of this Protuberance, one *Sinus* is seated, receiving the prominent parts of the heads of the Thigh-bone incrusted with a Cartilage.

And the outward Head of the said Bone doth incline more forward then the inward Head, and is more largely covered with a thin Cartilage; So also the outward *Sinus* of the *Patella* (placed at the outside of its Protuberance) is more large and broad then the inward *Sinus*.

The Surfaces
of the *Patella*.

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The *Patella* in that part, (wherein it is contiguous to the Thigh-bone) is smooth and slippery, and in its anterior region and sides it is rough, and beset with some obscure holes, and in its hinder part, is carried downward with an acute Process, and is rough, and adorned with small holes, that it might be the more fitly conjoyned to the Tendons, appertaining to the Tensors of the Thigh.

And this is peculiar to the *Patella*, that it is not tied to any Bone by the help of Ligaments, but strongly fastned only by Tendons (passing over the Joynt of the Knee) to the Bone of the Thigh.

Galen

Galen is of an Opinion that the *Patella* is endued with a soft Cartilaginous substance, which seemeth to contradict Autopsy, especially in Persons of mature age, in whom the Compage of the *Patella* is found to be very hard and solid.

In Sheep, Oxen, and the like, this Bone is much longer and more narrow than in Men, and in Fowls it is shorter and broader.

This Bone is formed by Nature to prevent a Luxation of the Joynt when the Knee is highly bent forward.

The Extreame Foot is composed of three ranks of Bones, of the *Tarsus* or *Pedum*, of the *Metatarsus*, or *Metapedium*, and of the Toes.

The *Tarsus* † is framed of seven Bones very different in shape and size; The first is called the *Talus* or *Astragalus*, which is endued with a head, received into the lower *Sinus* of the *Os Tibiæ*, from whose inner Process the inner Ankle is constituted, as the outward proceeds from the *Fibula*.

This Bone in its fore-part emits a Prominence, received into the *Sinus* of the *Os Naviculare*, and hath a lower Protuberance, which is conjoynd with the *Os Calcis*.

The *Os Tali* seemeth to be circumscribed with four Sides or Ribs; The first and second seem, according to their Sides, to run round in an Orb according to their length; The third is carried about the anterior part of the said Bone; And the fourth maketh its progress about the posterior part of it; So that this Bone appears after some manner to be adorned with a quadrangular figure.

The Protuberance of the *Talus*, according to its Sides (by which it is contiguous to the Ankles) is compressed, and incrusted with a smooth Cartilage, though not every way alike; In the inside it is very little compressed, because the Process (relating to the lower Appendix of the *Os Tibiæ*) maketh the inner Ankle, and this containing a side of the *Talus*, is incrusted for a little space with a smooth Cartilage; but the outside, belonging to the Protuberance of this Bone, is much hollowed, and covered for a great space with a Cartilage, that it might form a fit place to which the inner side of the outer Ankle might agree, which maketh its progress lower than the inner Ankle-bone.

And all the Joynt of the *Talus* with the Bone of the *Tibia*, and *Fibula*, and their mutual reception, the *Talus* is bent and extended without any considerable lateral motion.

And in the outside of the inner Ankle-bone is endued with a rough *Sinus*, out of which a cartilaginous Ligament (fastning the *Talus* to the *Os Tibiæ*) taketh its rise; And the inner side of the *Talus* is engraven with a rough *Sinus* for the reception of the said Ligament, and moreover the outer side of the *Talus* is hollowed, that it might admit a Ligament, coming out of the inner side of the outer Ankle-bone; And upon the account of these Ligaments, the hinder region of the *Talus* (placed at the foot of the fore-described Protuberance) is rough to entertain the Ligaments, taking their origination from the *Os Tibiæ*, and the *Talus* doth emit other Ligaments to the *Os Calcis*.

And beside this roughness the hinder region of the *Talus* is hollowed with a *Sinus* for the reception of the Tendons of Muscles: From the anterior region of the *Talus*, and chiefly from the inner side of it, ariseth an oblong Neck which making its progress for some space terminates into a round head (incrusted with a slippery Cartilage) which is received into a deep *Sinus* of the *Os Naviculare*, as making an articulation, by whose help the Foot makes an obscure lateral motion.

The Foot is composed of three ranks of Bones.

† T. 72. F. 1. l. 1.

The *Tarsus* is made up of seven Bones. The Head of the *Talus* is received into the *Sinus* of the *Tibia*.

The Bone of the *Talus* seemeth to be adorned with a quadrangular figure.

The Joynt of the *Talus* with the *Tibia* is bent and extended without any great lateral motion.

The rough *Sinus* of the Ankle-bone, out of which a Ligament is emitted, fastning the *Talus* to the *Os Tibiæ*.

† F. 1. k k.

The *Sinus* of the *Talus* made for the reception of Tendons of Muscles.

The round Head of the *Talus* (being incrusted with a Cartilage) is received into a *Sinus* of the *Os Naviculare*.

A double Articulation of the *Os Tali*.

Cartilaginous Ligaments fastning the *Talus* to the *Os Calcis*.

The second Bone of the *Tarsus* called *Os Calcis*.

The posterior part of the *Os Calcis* is brought backward that the *Os Tibiæ* might be supported in a perpendicular Line, and for the better insertion of the Tendon of the *Musculus Gasterocnemius*.
The Surface of the *Os Calcis* is rough.

The Connection of the *Os Calcis* with the *Talus*.

And the inferior region of the *Talus* hath a double Articulation with the *Os Calcis*, and is seated under it, and one Joynt consists in the lower region where the *Os Calcis* is protuberant with a large broad Head, received into a deep *Sinus* of the *Talus*; And the other Joynt is seated forward, inclining to the inner side of the Foot, and is framed after another manner different from the hinder Joynt; by reason the *Os Calcis* is here engraven with a long *Sinus*, which being incrufted with a Cartilage, doth entertain the lower region of the Head belonging to the *Talus*, articulated with the *Os Naviculare*; In the middle of these Joynts, the *Os Tali* and *Calcis* are endued with a roughness, and obtain deep *Sinus*, out of which do arise cartilaginous Ligaments, strongly fastning the *Talus* to the *Os Calcis*.

The rough *Sinus* of these Bones are deeply engraven; so if that these Bones be cleaned and conjoynd again, a great space may be seen between the *Os Tali* and *Calcis*, filled up with Cartilaginous Ligaments, which do so firmly fasten the said Bones to each other, that the *Talus* can be scarcely at all moved above the *Os Calcis*, and is so immovable in its lower region, as it is liable to motion in its upper.

The second Bone of the *Tarsus* is called *Os Calcis*, and is the greatest of all the Bones, and very long, extended backward, that a Man might more firmly rest upon the *Talus*, and not easily fall backward; and is not endued altogether with a round, but broad Figure, as a Base of progressive motion, and is somewhat rough and uneven, by reason in its lower region it is prominent cross-ways and downward, and emits a Process, from whose anterior region a Muscle takes its origen, which is a flexor of the second Bone relating to the Four Toes.

The posterior part of the *Os Calcis* is brought backward beyond a right position, that the *Os Tibiæ* might be supported by the Foot in a perpendicular Line, and that the most strong Tendon of the *Musculus Gasterocnemius* might be inserted into the hinder part of the *Os Calcis*, whose sides are rendered somewhat flat and broad, and the inner side is smooth and hollowed, that it might give a fit reception to the Tendons (making their progress to the lower region of the Foot) which are reflected about the hinder region of the *Os Calcis*, in which Nature hath engraven a *Sinus*, receiving the Head of the *Talus*, and making its Fore-joynt with the *Os Calcis*.

The outer side of the *Os Calcis* is not hollowed, but rough and uneven, and without Flesh, if the lower region be excepted, where the Muscle taketh its rise, which is the Abductor of the Little Toe: But the anterior part of this side is smooth, and somewhat hollowed, giving way to the Tendons of Muscles, which being reflected at the hinder part of the outer Ankle-bone, make their progress to the region of the *Os Calcis*.

This Bone is connected to the *Talus* in its hinder part by a strong Ligament made up of three Tendons relating to the Tensors of the Foot; and in its upper region doth enter into a *Sinus* of the *Talus* with a broad flat Head, and a little above the *Os Calcis* doth entertain a protuberance of the *Talus* into its *Sinus*, and hath another Prominence conjoynd with the *Os Cubiforme*.

The *Os Naviculare* (somewhat resembling a Boat in shape) in its lower region is endued with a deep *Sinus*, (which is oblong, if considered, cross-ways) into which the head of the *Talus* is received; The anterior part of this Bone is not altogether smooth, as being incrufted with a slippery Cartilage, and adorned with three prominent Surfaces, fitted to the three Bones of the *Tarsus*, articulated with it.

The

The upper region of this Bone is endued with a Concave Surface, as being somewhat Orbicular in figure, whereby it is most fit to oppose the assaults of outward accidents encountering the Foot; This higher part of the Bone is somewhat rough for the better propagation of Ligaments connecting it to the *Talus*, and some other Bones of the *Tarsus*.

The upper region of the *Os Calcis* is endued with a Convex Surface.

The lower part of the *Os Naviculare*, is hollow and slender to encrease the Concave Surface of the Foot, which is very conducive to progressive motion; And this Bone receiveth in its posterior part a Protuberance of the *Talus* into its *Sinus*; and its fore-part entreth with its flat heads into the *Sinus*, belonging to three Bones of the *Tarsus*.

The lower Region of the *Os Naviculare* is endued with a Concave Surface.

The *Os Cubiforme* hath this denomination from its figure, as resembling a Die, and by the Greeks *πολύμορφον*, as consisting of variety of shapes, and is conjoined to the *Os Calcis* in its uneven and rough figure, and in the other side is connected to the third Cuneiform Bone; and toward the Toes leaneth upon the fourth and fifth Bone of the *Metatarsus*.

The *Os Cubiforme*, and the reason of its Denomination.

The other three Bones of the *Tarsus* are called by some Anatomists *Innominata*, as having no Appellative, and by others *Cuneiformia* from their Figure, by reason from a more large Base, they grow more and more narrow in dimensions; and the first is greater then the third, and the least is seated in the middle, and supported by the other: All these three Bones being conjoined in their upper part, make the Convex and arched part of the Foot, and in their lower the Concave, and where they are connected to the sides of each other, they are incrusted with a smooth and slippery Cartilage, and are contiguous only in the lower part of their sides to the Navicular-bone, and in their other parts they are seated some distance from each other, which is filled up by the interposition of Cartilaginous Ligaments mutually conjoining them. These Bones are not adorned with any Appendices, and are endued with the same substance with the other Bones of the *Tarsus*.

Its Connexion with the *Os Cuneiforme* and Contiguity with other Bones. The Bones of the *Tarsus*, called *Cuneiformia*. The Dimension of the Bones. The Connexion of the *Os Cuneiformia*, maketh the Convex part of the Foot.

All these Bones of the *Tarsus* (called *Cuneiformia*) disagreeing in size and shape, have many Prominencies entring into various *Sinus* (lined with Cartilages) whereby they are tied to each other, and to the adjacent Bones by strong Ligaments.

The Prominences and *Sinus* of the *Os Cuneiformia*, are tied to each other by Cartilages.

The *Metatarsus* † is composed of five hollow Bones differing in length and greatness, disjoyned from each other in the middle, that they make room for the *Musculi Interossei*, and are adorned both and above and below with protuberant Heads; The first are received into the *Sinus* of the four lower Bones of the *Tarsus*, and the latter being beautified with a round Figure, do enter into the *Sinus*, appertaining to the first Bones of the Toes.

The Bones of the *Metatarsus*. † T. 72. F. 1. 0 0.

The *Musculi Interossei* seated in the spaces of the Bones of the *Metatarsus*.

And as the Bones of the *Tarsus* in their anterior part do not terminate in the same Line, so those of the *Metatarsus* have their terminations not in straight positions, but tend backward, and these Bones (where they are conjoined to the *Tarsus*) are more great, and are articulated with shallow *Sinus*; and where they come more near the Bones of the Toes, they are more small, and keep a greater distance from each other, in which the *Musculi Interossei* are seated as the Flexors of the first Joynt of the Fingers.

The upper Heads of the said Bones are received into the *Sinus* of the Bones of the *Tarsus*, and the lower Heads into the *Sinus* of the Bones of the Toes.

These Bones when they are articulated with the Toes, are adorned with an Appendix ending into one Head, received into the *Sinus* relating to the first Joynt of the Toes.

The articulation of the Bones of the *Metatarsus*, with the Bones of the Toes.

The Bone of the *Metatarsus* belonging to the great Toe, is the most large of all the Bones, and hath an orbicular Head, whereby it is moved more laterally then the rest of the Toes, and in that part where it is articulated with the *Tarsus*, and near the Floor, it emits a Process, into which a Muscle

The Bone of the *Metatarsus* belonging to the Great Toe.

of

The Bones of the *Metatarsus* adjoining to the Little Toe.

of the Foot is inserted. And the Bone of the *Metatarsus*, adjoining to the little Toe (where it is articulated to the *Tarsus*) hath an eminent Process tending to the outside of the Foot into which a Tendon of a Muscle is implanted.

† F. 1. m. m.

The Toes of the Foot (as well as the Fingers of the Hand) are endued with three ranks of Bones †, except the Great Toe, which is accommodated only with two Bones.

The Bones of the first Joynt of the Toes.

The Bones of the first Joynt (belonging to the Toes) are engraven with the *Sinus*, into which the Heads of the Bones of the *Metatarsus* are admitted, and are covered with Cartilages and fastned with Ligaments for the more easie and firm motion of the Joynts; and the said Bones terminate into Protuberances, which are received into the *Sinus* of the Bones, relating to the second Joynt of the Fingers; and so in like manner the Bones of the second Joynt do end into Prominencies, entertained into Sockets of the third Joynt, covered with Cartilages, and connected with Ligaments

The Bones of the second Joynt.

Small Bones lodged among the Tendons of the Foot called *Sesamoidea*.

And the Tendons of the Foot, as well as those of the Hand, are interspersed with divers small Bones (called *Sesamoidea*) from resembling the Seeds of *Sesami*. These Bones are different in shape and size.

And now I will speak a close to *Osteology*, in which I have given a brief History of the Bones of Man's Body, with the Descriptions of their several Processes, Cartilages, Ligaments, Articulations, and Originations; To which, that the *Osteology* may be rendred somewhat more compleat, I will add the Origins of the Bones of the lower Limbs, which come to maturity step by step.

The Thigh-bone in the first Month of a *Fœtus*.

The Thigh-bone in the two first Months of a *Fœtus* seemeth to be one continued Cartilage, without the least footstep of a Joynt, and at this time there can be discovered no appearance of the lesser *Focile* or *Fibula*.

The Bones of the *Tarsus* and *Metatarsus*, and Toes observe the same method with the Bones of the *Carpus*, *Metacarpus*, and Fingers. The *Ossa Tibia*, and *Fibula*, appear in the third Month.

In the Bones of the *Tarsus*, *Metatarsus*, and Toes, Nature observes the same method as in *Carpus*, *Metacarpus*, and Fingers of the Hand, which are wholly Cartilaginous, except in some small points, which are the first rudiments of Ossification.

In the third Month there is some appearance of the *Ossa Tibia*, and the *Fibula*, which have some beginnings of being rendred Bony, and the *Metatarsus* is for the most part Cartilaginous, and hath little appearance of the *Patella*.

The *Patella* and Bones of the *Tarsus* and *Metatarsus*, and Toes, begin to be Cartilaginous in the fourth Month.

In the fourth Month the *Patella* is Grisly, and in the *Tarsus* and *Metatarsus* some Centers of Ossification discover themselves, and in the Bones of the Toes, the lower Joynts first receive Points, the rough draughts of being rendred bony, when there is no appearance of it in the first and middle Joynts.

In

In the fifth and sixth Months, the first point appeareth in Joynt of the Great Toe, and afterwards in the middle Joynts of the other Toes.

In the fifth, sixth, seventh, and eighth Months, the *Ossa femoris, Tibia,* and *Fibula, Tarsi, Metatarsi,* and *Digitorum,* lose much of their Cartilaginous nature, and by receiving more earthy and saline Particles from the Blood, become more and more bony, and in the ninth Month the Joynts are finished, and the *Skeleton* of the whole Body attains to higher and higher degrees of perfection, giving greater strength and motion to it.

In the fifth, sixth, seventh and eighth Months, the *Ossa femoris, Tibia, Fibula, Tarsi, Metatarsi,* and of the Toes, become bony.

The P R A Y E R.

O Most Good and Great Heavenly Mind, how fearfully and wonderfully are we made! Thou hast covered our Bones with Flesh, and our Flesh with Skin (being a Contexture of many Nervous Filaments, curiously Interwoven) as with a fine Rayment.

Thou speakest thy high Attributes of Wisdom, Power, and Goodness in the Creation and Government of the Greater World, by rendring the various ranks of inferior Creatures subordinate to the use and dominion of the superior, and the superior again make their grateful returns in the management, improvement, and protection of the Inferior.

The Earth, as a common Parent, giveth birth and growth to Plants, and Plants afford Aliment to Animals, and Animals to Man; Wherefore we most humbly beseech Thee the Almighty and most Gracious Creator, to make the beauteous Oeconomy of Nature (expressed in the subjection of lower to higher Entities) a Monitor to us; That we, the Work of thy Hands, may pay our most humble Duty of Thanks and Obedience to Thee our most Glorious Maker; and thou being our Supreme Lord, be pleased to bless us thy Creatures with the Gracious Dispensations of thy Providence and Protection.

And in the lesser world of Man, the Epitome of the Creation, thou hast constituted in an admirable Order, the Faculties of the Soul, and Members of the Body, whose apartments (being beautified with a curious Frame) are Ministerial to each other, the lower to the middle, and both to the highest. In the lower the most Wise Architect hath formed the Stomach, Intestines, Spleen, Liver, and Kidneys, which being Contextures of many Vessels, are so many Elaboratories of Chyle, and Colatories of the Blood, wherein Secretions are made of its impure from the more pure parts.

In the middle Story, Thou hast laid the Chambers of the Heart in Waters, and hast outwardly Enameled it with divers branches of Blood-vessels, and more inwardly Embroidered it with various ranks of Muscular Fibres (after the manner of Network) as so many Organs to give motion, life, and refinement to the Blood, the Fountain Life.

Thou hast formed the Lungs (as an Organ of Respiration) a Systeme of divers Pipes and Vessels of Air to improve the Blood by
its

The PRAYER.

its Nitrous and Elastick Particles, and to fan and refresh the Vital Flame by its cold Atomes.

Thou hast outwardly encircled the highest Apartments with many common Integuments, and chiefly with the Tables of the Skull, as with Walls of Ivory, and within with finer Membranes, stretched out as Curtains, and Vails to cover and overshadow the bright intelligent Orb of the Brain, a white pulpy substance consisting of many Processes, beset with many streaks (which are a Contexture of many Fibrils) resembling rays of Light, through which the Emanations of Animal Spirits are diffused.

In the lower Story of a Humane Body, Thou turnest Aliment into Milk, in the middle, Milk into Blood, in the highest, its Crystalline part into Animal Liquor, enobled by choice Spirits. Grant O holy Jesus, the Great Physician of Soul and Body, that as our natural Life is preserved by these several changes, so our spiritual may be raised up by more noble Transmutations, that our Reason may be converted into Religion, and our Nature into Grace in this World, and our Grace into Glory in the World to come, through the Lord of Life and Glory; To whom with the Father and holy Ghost be all Praise, Dominion, Eucharist, Adoration, and Obedience, now and for ever. Amen.

THE

its Vitron and Elastic Particles, and to fan and refresh the Vital Flame by its cold Motion.

I have last curiously circled the highest Apartments with many common Integuments, and chiefly with the Tables of the Skull, as with Walls of Ivory, and within with finer Membranes, stretched out as Curtains, and Vails to cover and overshade the bright intelligent Orb of the Brain, a white pulpy substance consisting of many Processes, beset with many breaks (which are a continuation of many Fibrils) resembling rays of Light, through which the Emanations of Animal Spirits are diffused.

In the lower Story of a Humane Body, I have turned Aliment into Milk, in the middle, Milk into Blood, in the highest, in Circulation part into Animal Liquor, enabled by choice Spirits. Grant O holy Jesus, the Great Physician of Soul and Body, that as our natural Life is preserved by these several changes, so our spiritual may be raised up by more noble Transmutations, that our Reason may be converted into Religion, and our Nature into Grace in this World, and our Grace into Glory in the World to come, through the Lord of Life and Glory; To whom with the Father and holy Ghost be all Praise, Dominion, Honour, and Obedience, now and for ever. Amen.



To the Right HONOURABLE
The Lord CHARLES CHEYNE,

Vicount of NEW HAVEN.

My LORD,



THE great Complaisance, and
endearing Civility, with which
your Lordship treateth those
who have the Honor of your
Acquaintance, giveth me the
confidence, and you the Trou-
ble of this Paper, speaking
my Ambition to be farther

known to your Lordship, in presenting you with my most
Humble Duty, and mean Sentiments which cannot Contri-
bute

The E P I S T L E

bute any thing to the advancement of your great Knowledge; All that I can pretend to in this Humble Address to your Lordship, in reference to my Boldness, is to receive a favourable Pardon, as well as an Honourable Protection: The intrinsick Honour of your great reality, and most amicable Disposition, render me highly a Votary to your Lordship, for whom I have most Reverential, and Affectionate Esteems, and shall ever deem my Self very much Honoured to improve my utmost endeavours in your Service.

Your Lordship hath travail'd through many Countreys beyond the Seas, and made many Observations upon the various Governments of several Republicks and Kingdoms, and have not only studied Books, but Men, and have Learned the Virtues (and not the Vices of other Nations,) giving a Lustre to your Honourable Personage and Fortune, which you have made very Renowned in great Hospitality, by Caressing your Friends with a Noble and Kind Entertainment, the high Expresses of your most entire Love, which you have much more enobled by your Piety to God, in Obedience to his Holy Laws revealed in his Word, and in Justice to your Neighbour, in the strict observance of his Sanction and Golden Rule in the Gospel, Whatsoever ye would that Men should do to you, do you to them; And in sobriety to your own Person, in regulating your Appetites according to the more refined Dictates of rectified Reason.

And

And now I cannot conceal your other Moral Perfections, as first your great Loyalty and Veneration of the KING, our most Gracious Sovereign (whom God long preserve) with an high Reverence and Duty, as Gods Vicegerent.

And your Lordship hath a high Value and Affection for the Ministers of the Gospel, and their Sacred Office, and chiefly for the Function of Bishops, as Ecclesiastical Governors, Instituted by the Holy Apostles, that all things in the Church may be done Decently, and in Order, and to Reform the irregular Lives of unreasonable Men.

And your Lordship is not only a Loyal Subject of His Majesty, and true Son of the church, but a faithful Friend too (of which I have had very much experience) who study all ways possible in all good Offices of Love and Kindness, to promote the Interest and Happiness of your Acquaintance, and have a due Resentment of any Civilities paid to your Lordship, who are very prone upon all occasions to speak your grateful Returns by way of Compensation.

I have reason to believe I have long presumed upon your Patience, for which I humbly beg your Lordships Pardon, in recounting your Perfections, which I have performed in all sincerity, out of a Principle of Justice (without any Flattery)

DEDICATORY.

tery) in propounding you a great Exemplar for others to Love, Admire, and Imitate.

My Lord, to your Goodness, as great in Honour, and to your Honour, as great in Goodness; are Humbly presented this Free-will Offering, and the Author; and no Votary Can do more then make his Heart an Oblation, as Ambitious to bear the Name and Attribute, of being,

My LORD,

Your Lordships most Obedient,

And Obliged Servant,

SAMUEL COLLINS.

THE
PREFACE
TO THE
TABLES.

EXperimental Philosophy is highly advanced by the frequent Dissections of the Body of M A N and other Animals, which I have performed with all Care and Fidelity, that I might inspect the great Secrets of Nature, and declare the Wondrous Works of the All-wise and Omnipotent Protoplast, who hath made all things in Number, Weight, and Measure.

And I humbly conceive the great Use of Comparative Anatomy, is to illustrate the Structure, Actions, and Uses of Man's Body, which are sometimes more clear in that of other Animals, than in ours; as I have discovered in frequent Dissections to my great satisfaction, pleasure, and admiration; Whereupon I procured my worthy Friend Mr. *Faithorne*, an Excellent Artificer (if not the Best in the World in this kind) to Engrave the opened parts of the Body and Brain of Man and other Animals Designed from the Life.

Anatomy

The PREFACE

Anatomy is well worthy our high Esteems and great Study, speaking a great Accomplishment to Learned Persons of this Age, as it is very much conducive to the knowledge of our Great and Glorious Maker, and of our Selves, and other Animals, the wonderful Works of His Hands.

This Learned part of Philosophy declareth the infinite Attributes of the Almighty Creator, who inhabiteth the Light of Light, whom no Mortal Eye is able to see Face to Face, and live; Wherefore the All-wise Law-giver in compliance with our Capacity, hath given us the Book of the Creatures, wherein we may read His great Perfections, (imprinted in fair Letters) His Omnipotent Power, Incomprehensible Wisdom, and infinite Goodness.

His first Attribute appears in creating the goodly Fabrick of the greater World, containing variety of Excellent Creatures (as so many Rays of His most bright Essence) made by His Word out of Nothing; And Man, the Complement of the Creation, and Epitome of the Creatures, he created after his own Image in Original Righteousness, and Dominion over the Creatures: In this great Creature the Godhead of Nature appears very illustrious, in making the August and great Structure of Man's Body out of so minute Particles of Seminal Liquor, out of which an admirable variety of different Parts are formed.

The Bones are the Pillars of the Body, and Centers of Motion, composed into Joynts, mutually tied with many Ligaments, and increased with Cartilages; These Bones are vailed with Tunicles and cloathed with the more thick Robes of Muscles, moving the various Articulations in different Positions. This Magnificent Fabrick is enclosed with common Integuments, as with so many fine Walls, and the three Apartments are beautified with Membranes,
as

as with curious Hangings (consisting of many well-spun Filaments, close struck, and curiously interwoven with each other in variety of Postures) encircling the choice Householdstuff of the *Viscera*, as so many Colatories of the Blood made up of many Tubes of Arteries, Veins, Nerves, Lymphæducts, transmitting various Liquors into all Parts of this lovely Frame of the Body.

Anatomy also declareth to us the unspeakable Wisdom as well as Power of the most Heavenly Mind, in the great Artifice of setting together so many Similar and Dissimilar Parts in a due situation, Connexion, and a decent Figure, Magnitude, Number, and proper substance, and chiefly in the disposition of many different parts (subserving to each other) in admirable order.

This curious Art is a Key unlocking the Skull, the Ivory Cabinet of the Head, (shaded with Hair and im-mured with many other fine Coverings) whereby you may see the more Noble Jewel of the Brain (the Pallace of *Minerva*) encircled with fine Vails, investing the Mæanders of its Ambient parts, which being opened, you may treat your self with the fruitful Branches of divers Arterial and Venal Ducts, and with various *Sinus* as so many Cysters of Vital Juice, and the streaky compage of the Brain, consisting of many minute Fibrils, the Channels of Nervous Liquor, transmitting it through the Processes of the Brain into the more remote Apartments of the Body.

In this learned Academy of Arts and Sciences, the Rational, as a Sovereign Queen hath her Presence Chamber, where in the Faculties of the Understanding and Will are Celebrated, giving their Commands to the Concupiscible, Irascible, and motive Faculties, most readily obeying the Superior; Whereupon we may see, admire, and adore the infinite Goodness of the Creator, manifested by this curious

The P R E F A C E

ous Art of Dissecting, whereby we may clearly apprehend the actions and uses of Parts, as their principal end and perfection; the Mouth is a preparatory of Aliment, by Mastication, breaking it into small Particles impregnated with Air and Salival Liquor, and afterward the Meat is transmitted by the Gullet, as by a Neck into the body of the Stomach, where it is embodied with Serous and Nervous Liquor, as a *Menstruum* to colliquate and dissolve it into various parts, out of which a milky Liquor is extracted, and then it is discharged out of the Retort of the Stomach into the Serpentine Ducts of the Guts, to receive a farther Elaboration, as mixed with Bilious and Pancreatick Liquor, and afterward this Alimentary Liquor is carried by the milky Mesenterick Vessels into the common Receptacle, where it is associated with *Lympha* attenuating it, and then it is transmitted through the Thoracick Duct, into the subclavian Veins, where it espouseth a union with the Blood, and is farther conveyed into the right Ventricle of the Heart, where it receiveth a greater Comminution, and is thence imported through the various Blood-vessels into the substance of the Lungs, wherein it is impregnated with the Nitrous or Elastick Particles of Air refining the Blood, which being imparted to the left Chamber of the Heart, and by the ascending and descending Trunks of Arteries, and their Branches, into the Brain, Spleen, Liver, *Pancreas*, Kidneys, and Testicles, as so many strainers of the Blood to defæcate it from its more gross Recrements. And here we may see with Eucharist and Adoration the unspeakable Works of the Great Architect, which He hath declared in the most admirable Artifice of a Humane Body, in reference to its Structure, Actions, and Uses.

And Anatomy doth not only very much contribute to the knowledge of our Maker, but our Selves too, as we are Compounds of two Essential Parts, Matter and Form, Body and Soul, which celebrate her various Operations (while confined to our Body) by proper Organs of out-

ward

ward Senses duly qualified ; by reason all intellectual knowledge taketh its rise from outward objects first presented to the outward sensitive Organs ; and afterward communicated to the common Sense and Fancy, whose Phantasms being represented to the Understanding, produce the more elevated notions of Reason, giving her Dictates to the Will, which by her Commands bringeth the inferior Concupiscible, Irascible, and loco-motive Faculties into Acts.

Whereupon it must be inferred, That seeing the superior Faculties do use the outward senses of Hearing and Seeing, as their Ministers, Anatomy is very necessary to conduct us to the due qualifying of the Eyes, when indisposed, by teaching us the various Coats, Pupil, and Humors, which constitute the Eye, whose act is celebrated by visible Images (arrayed with Light) reflected from Opaque Bodies, and being conveyed through many more rare or dense transparent *mediums* of Tunicles and Humours, do make divers refractions, and at last make Appulses upon the *Retina* (the immediate subject of Vision) an expansion of the Optick Nerve, which being affected by the strokes of the *Retina*, communicates them to the Fancy, whose Phantasms, being represented to the Understanding, are productive of more sublime Sentiments.

Anatomy doth render the act of Hearing intelligible by discovering the Auditory passage, Muscles and Bones of the Ear, *Tympanum*, *Foramen ovale*, & *rotundum*, *Labyrinthus*, which convey Sounds, the various models of Air, making appulses upon the Auditory Nerve (the ultimate subject of Hearing) which are thence imparted by the continuation of Nerves to the inward Sensory, the Judge of outward Objects.

By Dissecting the Heart, we discern its Chambers (as the Cysterns of Blood) and the Tendinous and Carnous

The P R E F A C E

Carnous Fibres contracting the Cavities of the Heart, and out of its right Ventricle do impell the Vital Liquor into the Lungs, and out of the left Ventricle into the common Trunk, and into the ascendent and descendent Trunk of the *Aorta*, and their Branches transmitting Blood into all parts of the Body.

By this Art we discover the Cortical Glands of the Brain (as Systems of various Vessels) wherein the Nervous Liquor is generated, and conveyed through the Fibrous Compage of many Processes into the Trunks of Nerves, very conspicuous in the lower Region of the Brain, when it is laid open by Art.

By Anatomy we may discern the Glands of the Cutis, *Pancreas*, Spleen, Liver, Kidneys and Testicles, as so many collective Bodies of several Vessels, percolating the Blood; By it we may view the various Vessels, the different Channels of Liquors, and the Carnous and Tendinous Fibres contracting the Muscles, as so many Engines of motion.

By this Art we pry into the inward Recesses of the Body, the several Bones and their Protuberances and *Sinus*, framing different Articulations of Joints (whose motion is made easie by Cartilages, and rendred firm,) as encircled and fastned together by Ligaments.

By many curious Dissections great discoveries have been lately made in the Body of Man (and other Animals much improving the Theory and Praxis of Physick) of the Milky Vessels in the Mesentery, of the common Receptacle, and Thoracick Duct in the middle Apartiment, of the Lymphæducts in the Liver and other parts of the Body, of the many Tunicles of the Stomach and Guts, and of the Glands, and Nervous Compage

Compage of the Brain, and various Processes, and Animal Liquor, and of the Carnous, Nervous, and Tendinous Fibres of the Heart, of the Vesicles of Air and Lobules in the Lungs, and of the Glands in the Cutis, Mesentery, Spleen, Liver, Kidneys, and Testicles, of new Seminal Vessels in them, and of many actions and uses of the parts, and of the motion of the Chyle, *Lympha*, Blood, and Nervous Liquor.

The principal end and accomplishment of Physick is its *Praxis*, relating to Diagnosticks, Prognosticks, and Therapeuticks, which are all derived *a parte affecta, & actione laesa*; both these are made known by Anatomy, whereby we inspect the outward parts, and the more inward Recesses, the *Viscera*, whose penetrals are discovered by Dissections; So that no person can truly deserve the appellation of a Learned and able Physician, which is not well versed in Anatomy, whose precepts relate to Physiology, and are the first rudiments of our Art, without which we cannot truly judge the nature of a Disease, manifested in the part affected, and the actions of fended.

And to this end to promote the Art of Physick; (which hath been my long Study and Employment) I have been concerned in many Dissections of the Body of Man, to contribute my Mite to the improvement of Experimental Philosophy, depending upon Anatomy, the chief part of Physiology, which is much advanced by the Dissections of the Bodies of other Animals, as well as that of Man, to render his Parts more clear, and intelligible.

So that I have with great Care and Faithfulness laid open various kinds of Creatures to inspect their *Viscera*, which I have ordered to be curiously drawn with a Penfil from the Life in many Schemes, beautified with variety of Elegant Figures (Engraven in Copper-Plates)

The PREFACE

as so many Monuments of Art, and Copies of Nature, lively representing the Noble Parts of the Body of Man and other Creatures, faithfully recommending them to Posterity, that the Republick of Learning may have a recourse to them to revive their Notions, gained by great Observation, made by Autopsie upon the Bodies of Animals.

These curious Tables, embelished with the Images of various Parts, may be termed Natures fine Pictures, copied by Art, wherein we may read God's most admirable Works, (as so many Products of His infinite Essence) written in fair Characters in the Book of the Creatures, composed of divers Volumes (disposed in excellent order) consisting of several fine Leaves, bound up with great Artifice, teaching us to know, love, and adore the Supreme Good, the Author of all Being, Goodness, and Perfection.

Table I.

The Following
S C H E M E S,

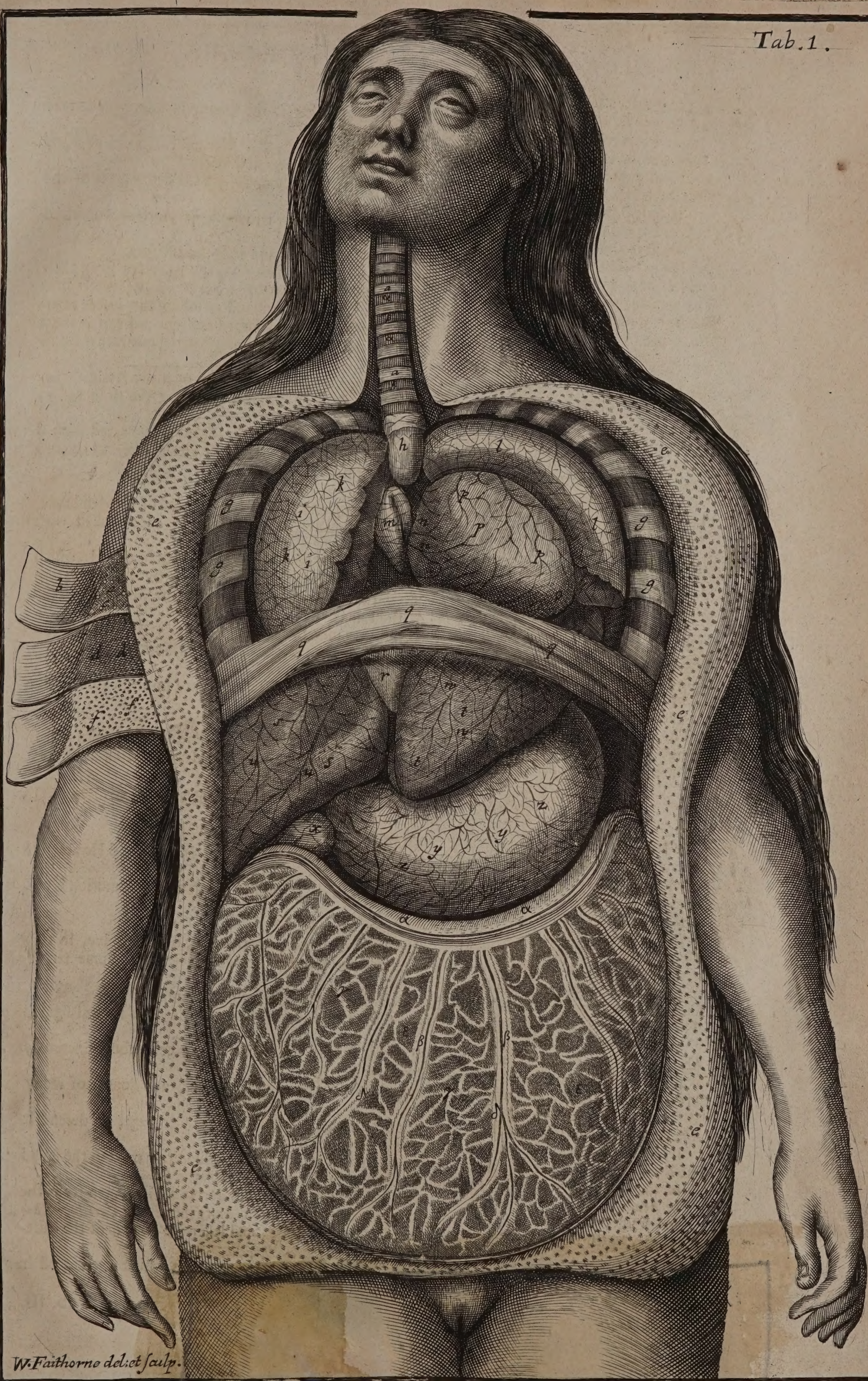
Are Adorned with many
F I G U R E S,

Representing the *VISCERA* of
MAN and other Animals;

Engraven in large Copper-Plates.

Tab. I. *A Humane Body opened.*

- a a.* **T**He Cartilages of the *Aspera Arteria*, which are not perfectly circular.
a a. The long Fibers passing down the *Aspera Arteria*.
β β. The circular Fibers every way surrounding the *Aspera Arteria*.
b b. The outward Skin of the Arm being turned back, the first and Reticular Coat of the inward Skin appears.
c c. The *Papillæ Pyramidales* (seated in the wrinkles of the Skin) are derived from the Nervous Coat, and terminate into the *Cuticula*.
d d. The Reticular Coat of the Skin being turned up, the Nervous appears, being composed of long, transvers, and oblique Filaments.
e e. The minute Membranous Fibers, are derived from the *Membrana Musculorum Communis*, and passing through the Fat and *Membrana Adiposa*, are inserted into the Skin.
f f. The Nervous Coat being turned back, the Glandulous discovereth it self, beset with small Glands, which are Colatories of the Blood having recourse to the Ambient part of the Body.
g g g g. Part of the Ribs seated on each side of the *Thorax*.
h. The *Thymus* (being fastned in its Base to the *Pericardium*) climbeth up till its top arriveth the highest Rib.
i i. The right Lobes of Lungs turned toward the right side.
k k. The numerous divarications of Blood-vessels, seated in the Surface of the right Lobes, after the manner of Network.
l l. The left Lobes of the Lungs (lifted up that the Heart may appear) are beautified with Blood-vessels after a reticular manner.
m m. The right Auricle of the Heart, surrounded with many circular Fibers, running Horizontally.
n n. The Base of the Heart seated exactly in the middle of the *Thorax*.
o o. The Cone of the Heart inclining toward the left Pap.
p p p p. The Coronary Blood-vessels Enameling the Surface of the Heart.
q q q. The Diaphragm passing horizontally in an Arch, parteth the lowest Apartment from the middle, and hath in its Relaxation a Convex Surface toward the *Thorax*, and a Concave toward the Belly.
r. The broad suspensory Ligament, derived from the *Peritonæum*, by which the Liver is fastned above to the Midriff.
s s. The right Region of the Liver turned backward, that the Stomach may be discerned.
t t. The left Region of the Liver, being put out of its situation, inclineth toward the left Hypocondre.
u u. The Blood-vessels branching themselves upon the Surface of the Liver after the manner of Network.
w w. The minute Glands besetting the ambient parts of the Liver.
x x. The Bladder of Gall, which in its natural situation is lodged in the concave part of the Liver.
a a. The Trunk of the Gastrepiploick Vessels running horizontally over the Caul after the form of an Arch.
β β. The Gastrepiploick Vessels, sprouting out of the Trunk, are branched downward all along the Caul.
δ δ. The greater Adipose Ducts accompanying the Blood-vessels.
γ γ. The more numerous small Adipose Ducts, seated in the *Area* † of the greater
† *s s.* Vessels, are branched after the manner of a curious small Network.
γ γ. The body of the Stomach appearing upon the turning up the Liver.
z z. The first Coat of the Stomach Enameled by Blood-vessels.



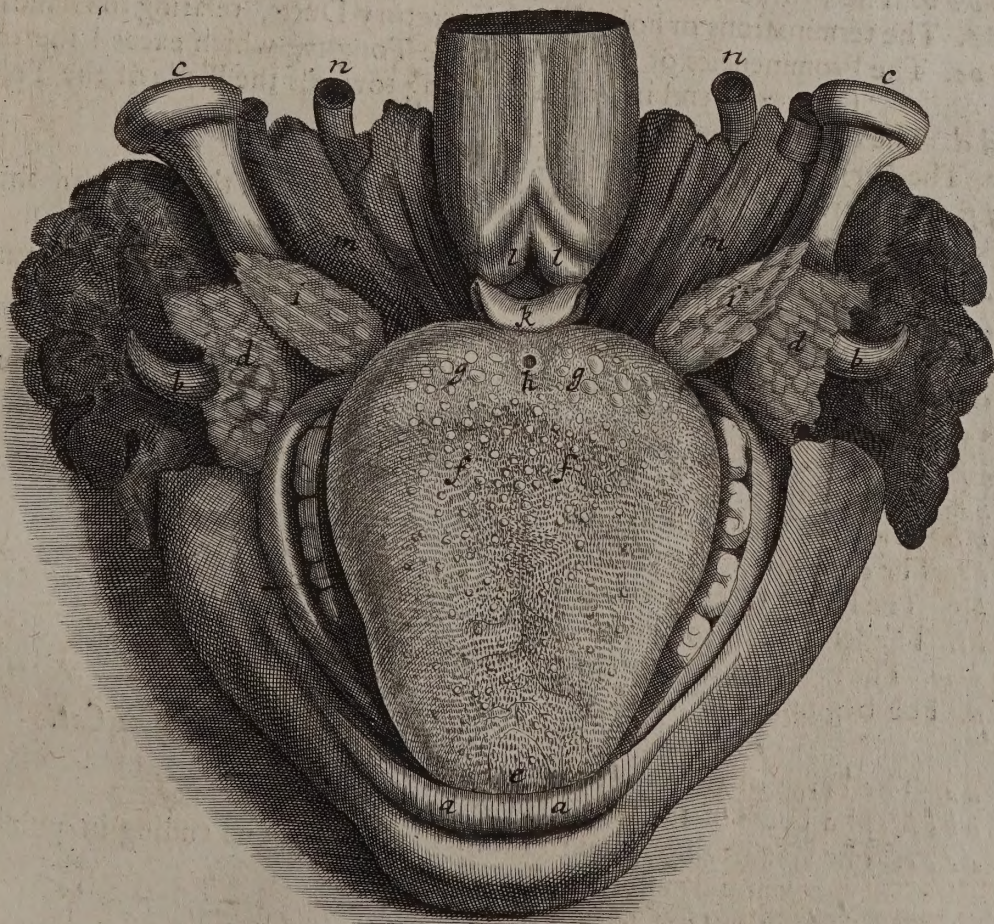
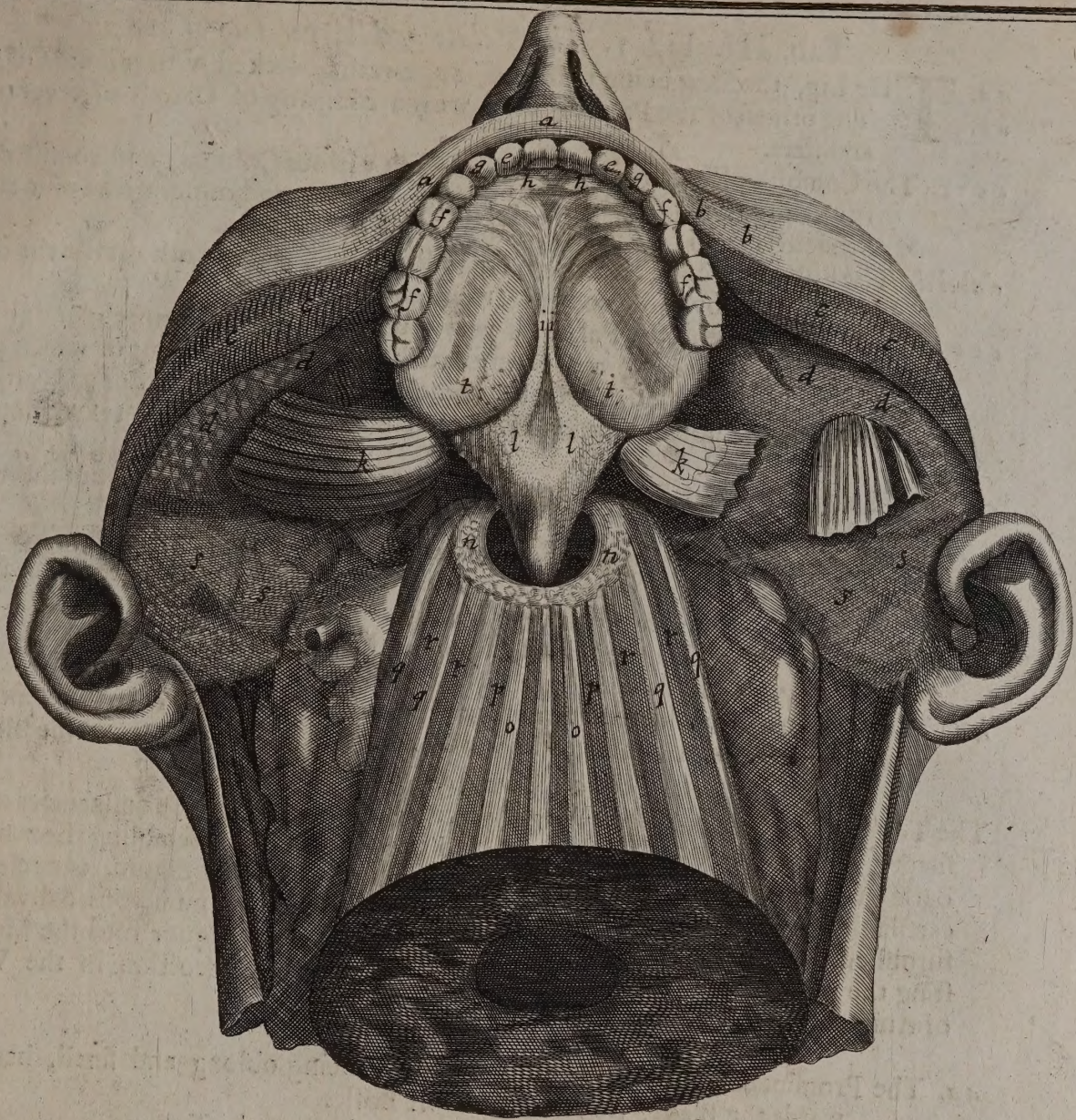
Tab. II. Fig. I. Represents the Upper-Lip, Cheeks, Teeth, Palate, Uvula, of a Man.

- a a.* The transverse Fissures of the Upper-Lip.
b b. Some part of the Upper-Lip stripped of its Coat, wherein the spongy substance of it may be discovered, as interspersed with many minute red Glands.
c c c. The Fat of the Cheeks cut open, wherein are seated many Particles of Fat, as in so many Membranous Cells, resembling Glands of divers magnitudes and figures.
d d. The Cheek being cut, many small Glands may be discerned accompanying the fleshy parts of the Buccinators.
e e. The four Fore-Teeth are called *Incisores*, from their thin edg, whereupon the Antients conceived them to cut the Aliment.
g g. The Dogs Teeth are seated on each side, near the great ones, and assist the Incisors.
f f f f. The Great Teeth, called by the Antients *Molares*, or Grinding-Teeth, so called from their motion inward and outward exerted by the *Musculi Pterigoidei interni & externi*, whereupon the Aliment is broke into small Particles, but in truth the common actions of the lower Mandible (in which the Teeth are fastned) are celebrated downward and upward (to make a comminution of the Aliment into small Particles) not by way of grinding but rather stamping or pounding the Aliment.
h h. The Glands, covered with white tough Membranes, are seated in the top of many Arches, (toward the beginning of the Palate) sprouting out of two Trunks, crowning the Branches as with Fruit.
i i. The double Trunk (running the whole length of the middle of the Palate) is parted with a long Fissure, and dividing the Palate and *Uvula* into Portions. The holes seated toward the end of the Palate, are terminations of the Conglomerated.
k k. Part of the Muscles, which I deem to be *Malleeters*.
l l. The *Uvula* is broadest in the middle, and endeth in a Cone, and being denuded of its Membrane, it may be plainly seen to be a Body composed of many Glands, which are encompassed with one common Membrane.
m m. The Cavity, seated beyond the *Uvula*, is encircled every way with Conglomerated Glands, which discharge themselves into it as into a common Duct or Cistern; this Cavity receiveth Air from two Cavities of the Nostrils, and transmitteth it through the Cavity of the Mouth into the *Larynx*, *Aspera Arteria*, and *Bronchia* of the Lungs.
n n. The entrance of the Cavity is encircled with divers minute Glands.
o o. The tendinous Fibres of long Muscles, are seated near the Vertebrae of the Neck.
p p. The Carnous Fibers of the long Muscles.
q q q. The tendinous Fibers of the *Scaleni* which assist the long Muscles and are both Flexors of the Neck.
r r r r. The fleshy Fibers of the *Scaleni* placed between the tendinous.
s s s. The Glands relating to the outside of the *Maxilla*, called *Glandes Maxillares externi*, into which an incision being made, many small Glands do offer themselves, placed not far from the Ear.

Fig. 2. Represents the Lower-Lip and Tongue of a Man.

- a a.* The Lower-Lip is of a Semicircular figure when the Mouth is opened.
b b. The acute Process of the lower Mandible, called by the Antients *Corone*, is a pointed Head upon which the motion of the lower Mandible is performed.
c c. The blunt Process, is the greater termination of the lower Mandible, upon which its motion is accomplished as upon a Center.
d d. Within the lower Mandible are seated numerous Glands.
e e. The tip of the Tongue is furnished with divers Figures preternatural, as I conceive, in this Body, and is interspersed with divers red minute pointed Protuberancies, and some larger round Prominencies.
f f. The middle and root of the Tongue is embossed with larger white round Prominencies.
g g. The termination of it is enlarged with two Hillocks beautified with many Glands of several figures and magnitudes.
h h. About the Root of the Tongue is seated a round hole, into which I conceive some Excretory Glands of the Tongue do discharge themselves.
i i. On each side of the Tongue are seated two Glands in a transverse posture, and consist of many small Conglomerated Glands.
k k. The *Epiglottis* is a Cartilage that covereth the *Rimula* of the Eure-like Cartilage, to defend it from the trouble of Meat and Drink passing into the Gullet.
l l. The *Rimula* of the *Cartilago Arytenoideis*, which in its contraction and dilatation maketh the sound of the Voice grave or acute, which is performed by divers Muscles of the *Larynx*.
m m. The *Musculi Hyothyroidei* which cover the Buckler Cartilage, and derive their origin from the lower side of the *Os Hyoideis*, and are inserted into the lower Margent of the *Cartilago Thyroideis*, which being contracted lift up the Buckler Cartilage, and lessen the *Rimula* of the Eure-like Grille.
n n. On each side of the *Cartilago Thyroideis* are seated two Carotide Arteries which are cut off in this figure.

Tab. III.



Tab. III. Fig. 1. *The Palate and Upper-Lip of a Calf.*

- a a.* The Lip, the Skin being taken off, appeareth bedecked with minute Glands.
b b. The origen of the Palate is beset with a company of Glands of several shapes and sizes.
c c c c. The Comblike Proccesses are beautified with various Colours, and consist of many rows, supplying the defect of the Fore-Teeth, and run cross-ways in a kind of Semicircles, and are parted in the middle by a Fissure.
d d d d. The Fissure running all along the middle of the Palate, doth divide the opposite Combelike rows of Proccesses, from each other.
e e e e. The hinder part of the Palate is very much wrinkled and more glandulous then the anterior Region, and is perforated in divers places, out of which the Salival Liquor destilleth out of the numerous small Glands in order to Mastication.
f f f f. The white Protuberancies seated on each side of the Cheeks, resembling Barley Corns.
g g g g. The grinding Teeth seated on each side of the upper Mandible about the middle of the Palate.
h h. The system of Glands being of a Semicircular figure, which are the *Tonsillæ*, and are seated on each side of the Palate near its termination, and near the Root of the Tongue, to which they are adjacent.
i i i i. The holes by which the Salival Liquor is discharged out of the Tonsils into the Cavity of the Palate.
k k. The Aperture into which do terminate the Cavities of the Nostrils, by which the Air and Breath are conveyed forward and backward into and from the Mouth.

Fig. 2. *The Tongue of a Calf.*

The Tongue of a Calf is beset with many greater and less pointed Prominencies of various shapes, some being Circular, and others Triangular, some resembling Lozenges, and Barley Corns, and others are Pyramidal, of oblong roundish Figure, encircled with a cartilaginous and horny substance; these Prominencies are numerous Salival Glands, furnished with Excretory Ducts discharging a thin Limpid Liquor into the Mouth assisting the mastication of Aliment, and preparing it for Concoction in the Ventricles of Animals.

- a a.* The Prominencies of the tip of the Tongue being oblong and small, bending towards the Blade, do resemble short Bristles.
b b b b. The Protuberancies of the Blade being the least of the Tongue.
β β. The terminations or holes of the Excretory Ducts, relating to Glands.
c c c. The Prominencies of the Root of the Tongue, which exceed the other in dimensions, and end in Points inclining towards the Blade of the Tongue.
d d. The Bones of the *Os Hyoides*.
e. The *Larynx* or beginning of the *Aspera Arteria*.
f f. The Eury-like Cartilages having a *Rimula* passing in the middle of them.

Fig. 3. *The Palate of a Cat.*

- a a.* The small Teeth of the upper Jaw seated in the beginning of the Mouth.
b b. The two long Teeth or Fangs.
c c c c. The greater and smaller Teeth of the upper Jaw.
d d. The first Arches of Glands in the Palate that are less in circumference.
e e. The second Arches of Glands that grow greater.
f f. The third Arches of Glands.
g g. The fourth Arches of Glands.
h h. The fifth Arches of Glands.
i i. The sixth Arches of Glands.
k k. The Palate furnished with a Glandulous substance.
l l. The less bony Prominencies.
m m. The greater bony Protuberancies.
n. The beginning of the Spine.

Fig. 4. *Of the lower Jaw and Tongue of a Cat.*

- a a.* The Fangs of the lower Jaw.
b b b b. The Teeth of the lower Jaw.
c c c c. The Cartilaginous long Proccesses of the Tongue ending in points, seated in the origen and middle of the Tongue.
e e. The Glandulous soft part of the Tongue.
f f. The Cavities seated in the termination or Root of the Tongue, out of which the Salival Liquor is discharged into the Mouth, in order to Mastication.
g. The *Epiglottis* covering the *Larynx* in eating.
h. The Eury-like Cartilage.

Fig. 3.

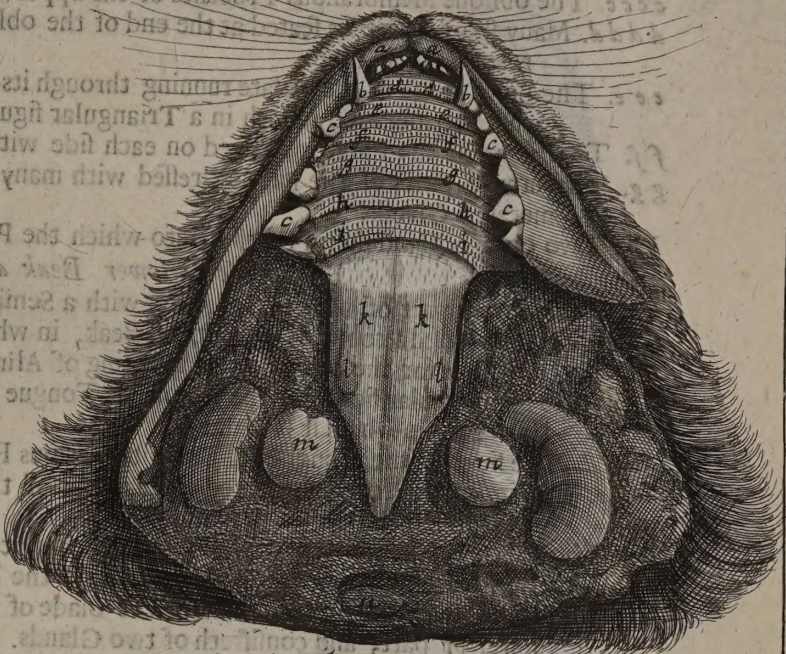


Fig. 4.

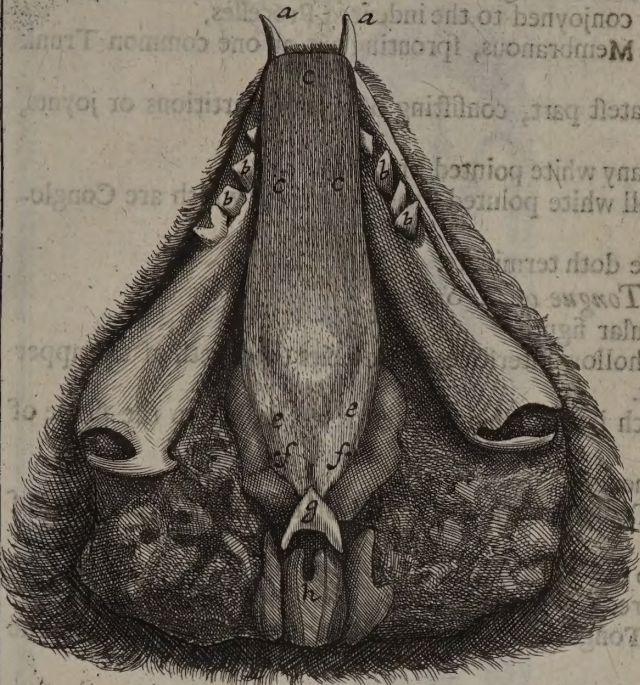


Fig. 1.

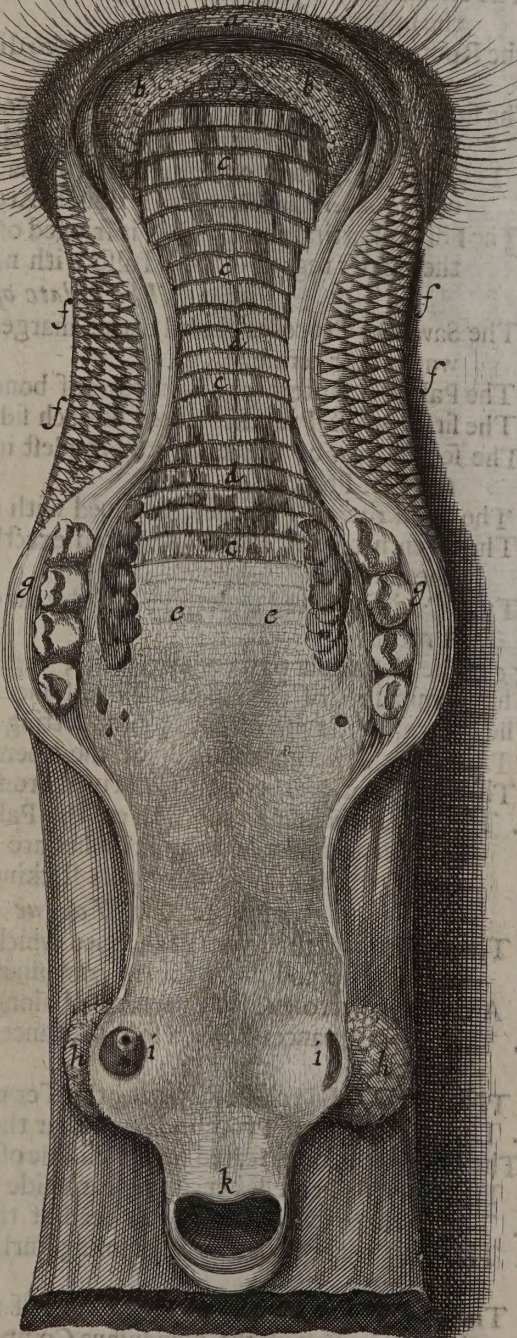
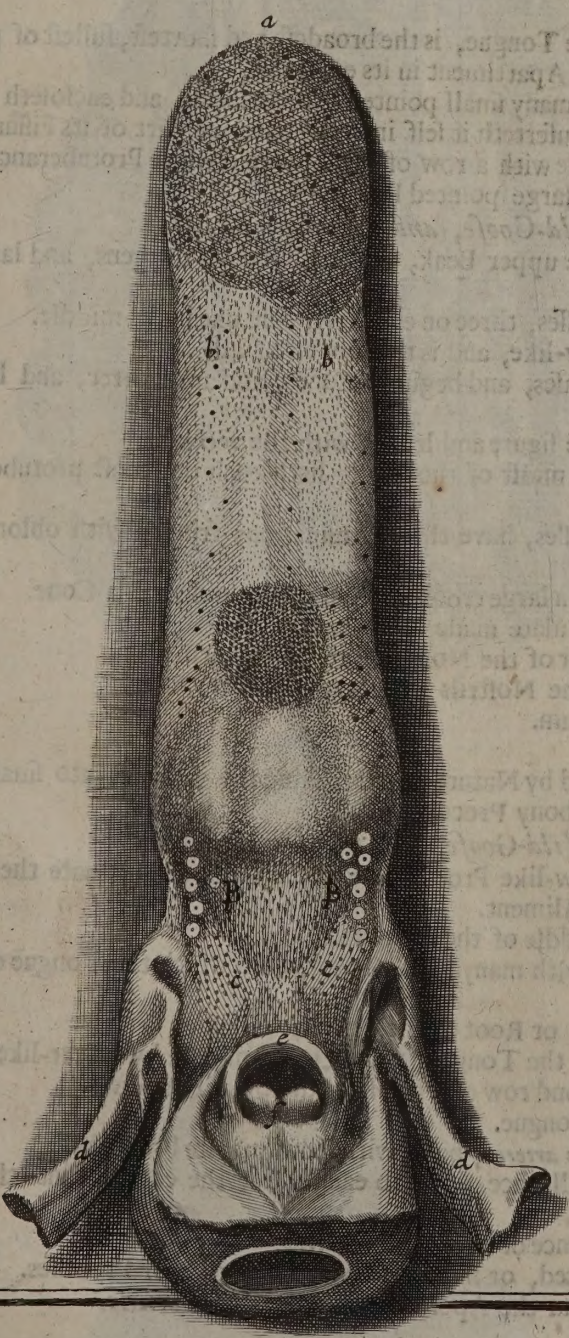


Fig. 2.



Tab. IV. Fig. 1. *Of the upper Beak and Palate of a Swan.*

- aaa.* The Semicircular figure of the origin of the upper Region relating to the Beak of a Swan.
bbbb. The indented Processes resembling Teeth seated on the margent of each side of the upper Beak.
cccc. The oblique Membranous Processes of the upper Beak conjoynd to the indented Processes.
dddd. Many short Processes seated at the end of the oblique Membranous, sprouting out of one common Trunk resembling a Tree.
eee. The bony ridge of the Palate running through its greatest part, consisting of many partitions or joynts, whose termination endeth in a Triangular figure.
ff. The Fissure of the Palate, fringed on each side with many white pointed Processes.
gg. The utmost parts of the Palate dressed with many small white pointed Protuberancies, which are Conglomerated Glands.
bb. Two oblong glandulous Processes into which the Palate doth terminate.

Fig. 2. *The lower Beak and Tongue of a Swan.*

- aaa.* The lower part of the Beak adorned with a Semicircular figure.
bbbb. The indented Processes of the lower Beak, in whose hollow Interstices or Cavities the Teeth of the upper do play for the reception or grinding of Aliment.
ccc. The Semicircular figure of the tip of the Tongue which is very thin, modelled according to the shape of the Beak, in which it is lodged.
dddd. The sides of the Tongue fringed with various Filaments.
eeee. The indented Processes (seated on each side of the Tongue towards the end of the Blade) consisting of divers Filaments.
ff. The Fissure of the Blade of the Tongue dividing it into two equal parts.
gggg. The pointed Glands seated on each side of the Fissure.
bb. The white glandulous termination of the Blade of the Tongue more thick, plump, and prominent then the anterior part, and consisteth of two Glands.
i. The Fissure of the posterior part relating to the Blade of the Tongue.
kk. The termination of the Blade fringed with three rows of pointed Processes set one above another, of which the uppermost is the largest.
K. The Root of the Tongue consisteth of two divisions, and is composed of a soft glandulous substance covered with a thin Membrane.
ll. The first division or flory relating to the Root of the Tongue, is the broadest and shortest, fullest of pointed Processes, enclosing the beginning of the second Apartment in its embraces.
mm. The second division, or Apartment, is made up of many small pointed Prominencies, and encloseth the top of the *Aspera arteria*, with a double Arch, and inserteth it self into the anterior part of its Fissure.
nn. The Fissure parting the *Larynx*, is fringed on each side with a row of small pointed white Protuberancies, and the hinder region is dressed also with numerous large pointed Prominencies.

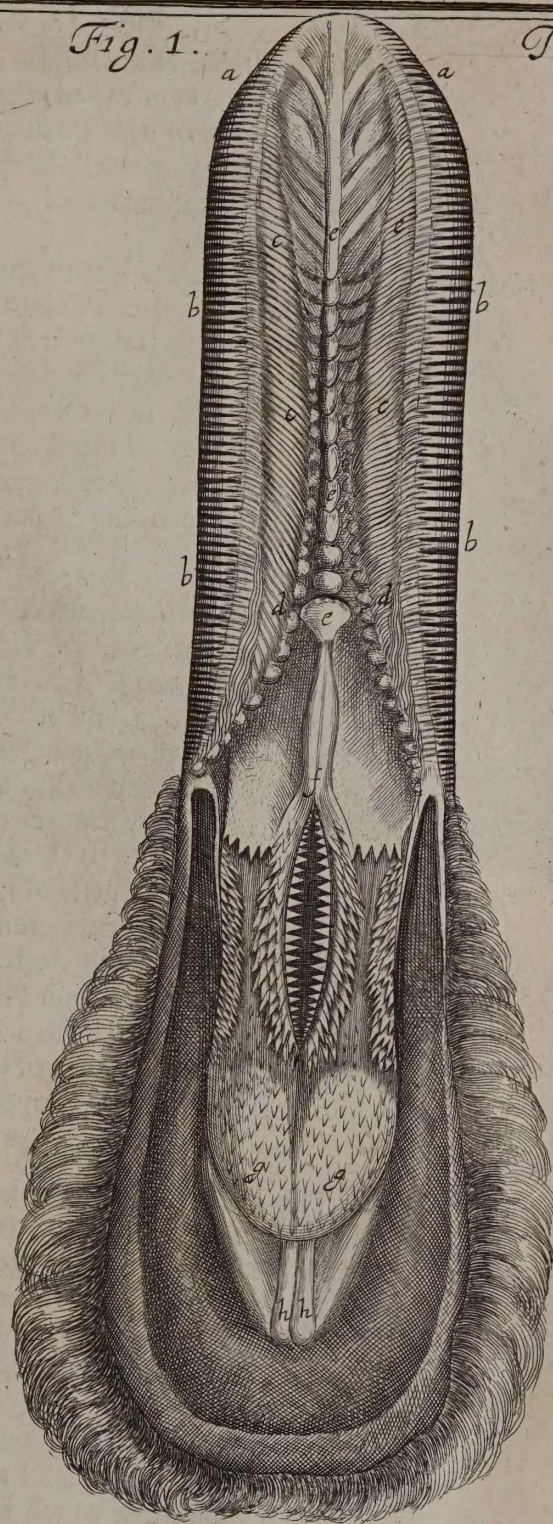
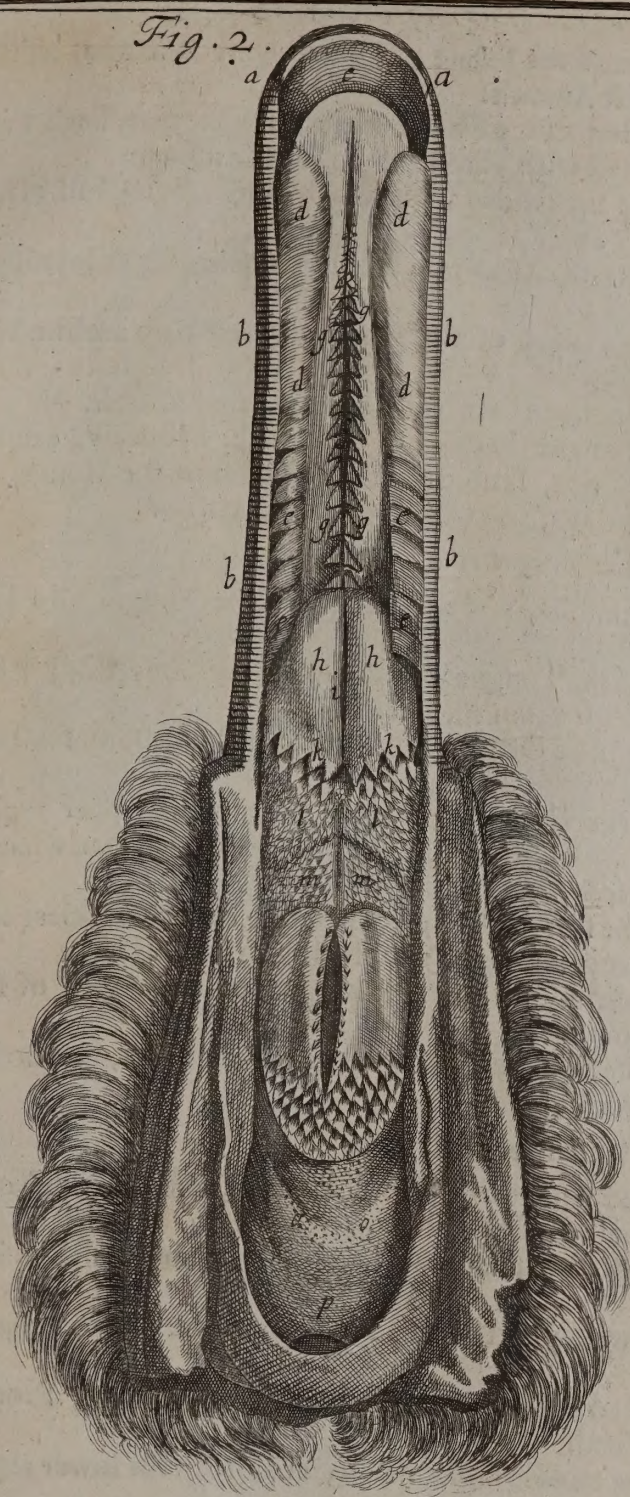
Fig. 3. *The Palate of a Wild-Goose, and the upper Beak.*

- aa.* The Saw-like Processes seated in the margent of the upper Beak, are small in their Origenes, and larger toward their terminations.
 The Palate consisteth of seven rows of boney Processes, three on each side, and one in the middle.
bb. The first row of Processes seated on each side, is Saw-like, and is the longest of all.
cc. The second row of Processes are broadest in their Bases, and begin in Cones, and are shorter, and less then the first Processes.
dd. The third row of Processes is endued with the same figure and length with the second.
ee. The seventh row of Processes, seated exactly in the midst of the other, hath each one most protuberant in the middle.
ff. Two Cavities placed under the middle row of Processes, have their terminations fringed with oblong small Processes.
gggg. The glandulous parts of the Palate, beginning in a large crooked Figure, and ending in a Cone.
h. The termination of the glandulous substance of the Palate made in a Cone.
i. The Fissure, or Cavity of the Palate, letting in Air out of the Nostrils into the Mouth.
kk. The Fringe besetting each side of the Aperture of the Nostrils with small pointed Processes.
ll. The Origen of Nerves cut off, derived from the Brain.
mm. The Bones enclosing each side of the Palate.

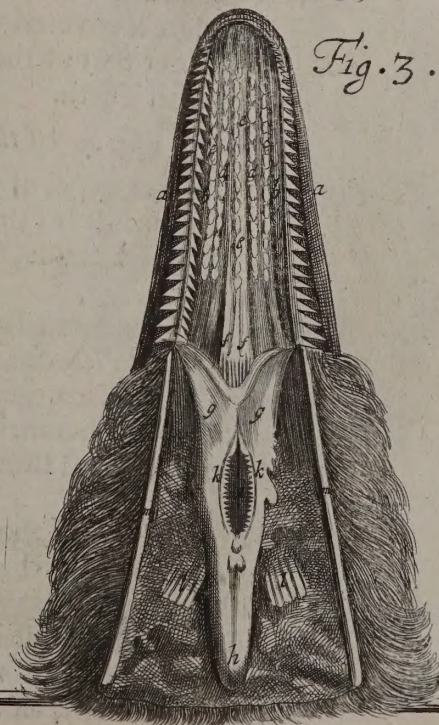
The diverse ranks of bony Processes are instituted by Nature, for breaking the Aliment into small Particles, which I saw in some part sticking to the bony Processes.

Fig. 4. *The Tongue of a Wild-Goose, and the lower Beak.*

- aa.* The Cavities of the lower Beak, into which the Saw-like Processes of the upper, do insinuate themselves, and play up and down for the comminution of Aliment.
bb. An oblong narrow Cavity running all along the middle of the Tongue.
ββ. Two Protuberances being a soft substance, beset with many small Glands, into which the Tongue doth terminate.
cc. The first row of Processes fringing the Termination, or Root of the Tongue.
dd. The second row of Processes seated near the root of the Tongue, parted in the middle by a Star-like Process.
e. The Star-like Process seated in the middle of the second row of Processes, dividing it into two.
ff. The Saw-like Processes enclosing each side of the Tongue.
gg. The entrance into the *Larynx* or head of the *Aspera arteria*, beset with short minute Processes.
hh. The small white Processes resembling Purl, or small Lace, fixed to each side of the entrance into the *Aspera Arteria*.
ii. The glandulous part placed on each side of the entrance of the *Aspera arteria*.
 The termination of the glandulous Compage is laced, or beautified with many rows of Processes.
kk. The first row of oblong narrow Processes, seated near the Aperture, into the *Aspera arteria*.
ll. The second row of Processes.
m. The third row of Processes.
nn. The irregular Processes.
oooo. The arched Bones encircling each side of the glandulous substance, placed about the entrance of the *Aspera arteria*.



Tab. 4.



Tab. V. Fig. 1. *The Palate of a Gurnet.*

- aaaa.* **T**He Semicircular confines of the Palate of a Gurnet, are somewhat alike the upper Lip of more perfect Animals.
- bb.* The origen of the Palate is guarded with a Semi-circle, beset with many small Teeth.
- cccc.* The Arch of the Palate is invested with a Silver coloured Membrane.
- dddd.* The termination of the Palate is attended with two Protuberancies, full of small Teeth.
- eeee.* The Gills are affixed in their extremities to two bony Prominencies adjoyning to the end of the Palate
- Beyond the Palate is seated the Origen of the Spine, covered with a white Membrane †, full of numerous streaks.
- † *ff.* On each side of the said Membrane are placed many small Glands. †
- The Glands of the Palate and Tongue in this and other Fish, I conceive are salival, attended with excretory Ducts, spuing out a Liquor into the Mouth, and carried into the Gullet and Stomach, as conducive to Concoction.

Fig. 2. *The Tongue of a Gurnet.*

- aa.* The Semi-circles parted in the middle, and adjoyning to the Tongue, do somewhat resemble a Lip.
- † *bbb.* Between the Lip and the tip of the Tongue is lodged a glandulous Body † beset with minute Glands, covered with a thin Membrane.
- cc.* The Tongue of a Gurnet is plump in its Origen, and is composed of a bony substance, enclosed within a thin Coat.
- † *ddd.* The bony Semi-circles of the Gills are embossed in their upper regions, (adjoyning to the Tongue) with bony Knobs or Prominencies † somewhat like the great Teeth of more perfect Animals.
- eee.* Within the circumference of the first Gill, are lodged two Protuberancies (somewhat resembling Pectoral Lozenges in shape) dressed with small Teeth.
- ff.* Beyond the two rough Protuberancies in a Gurnet, are seated a company of small Glands, covered with a Membrane.
- gg.* About the termination of the Palate beginneth the entrance of the Gullet, in whose inside being opened, appear many folds.

Fig. 3. *The Palate of a Pike.*

- aaa.* The Palate of a Pike is fortified with three Protuberancies, of which those of the sides are broadest and shortest, all dressed with pointed Teeth.
- bbbb.* The longest Teeth are those of the side Prominencies, confining on the middle
- cc.* Protuberance, or *Septum*.
- dd.* The Anterior part of the bony Intersepiment, seated in the middle of the Palate, is divided into two branches.
- † *ee.* A third Protuberance † (seated between the two branches of the bony Process) is dressed with many minute Teeth.
- ffff.* The Process passing all along the middle of the Palate, is to fortify the lower regions of the Skull, which is very thin for the most part.
- gggg.* The Palate is covered with a thin Membrane full of wrinkles.
- hhbb.* The hinder part of the Palate is enclosed with Gills, beset in their lower region with small Teeth.

Fig. 4. *Of the Tongue and parts adjoyning of a Pike.*

- † *aaaa.* The upper edges of the lower Mandible † are garnished with sharp Teeth.
- bbbb.* Between the sides of the Mandible, and near the fore-part, and under the beginning of the Tongue, is seated a glandulous substance, clothed with a fine Membrane.
- cc.* The Tongue is composed of a bony substance, vailed with a thin Coat.
- ddd.* To this bony Process adjoyning to the Tongue, is affixed two Protuberancies, dressed with many small Teeth.
- eeee.* The bony Protuberancies and the Gills in a great part, are encompassed on each side with a broad thin Bone, beautified in its outside with a Silver-coloured Membrane.
- ffff.* The originations of the Gills are conjoyned, either higher or lower, to the bony Process joyned to the Tongue.
- gggg.* The Gills have their sides fringed with Blood-vessels, and their upper region dressed with small sharp Teeth.
- hhbb.* Within the inmost Gills are seated two Protuberancies, placed above the Apartment (in which the Heart is lodged) and are furnished with a number of small Teeth

Fig. 1.

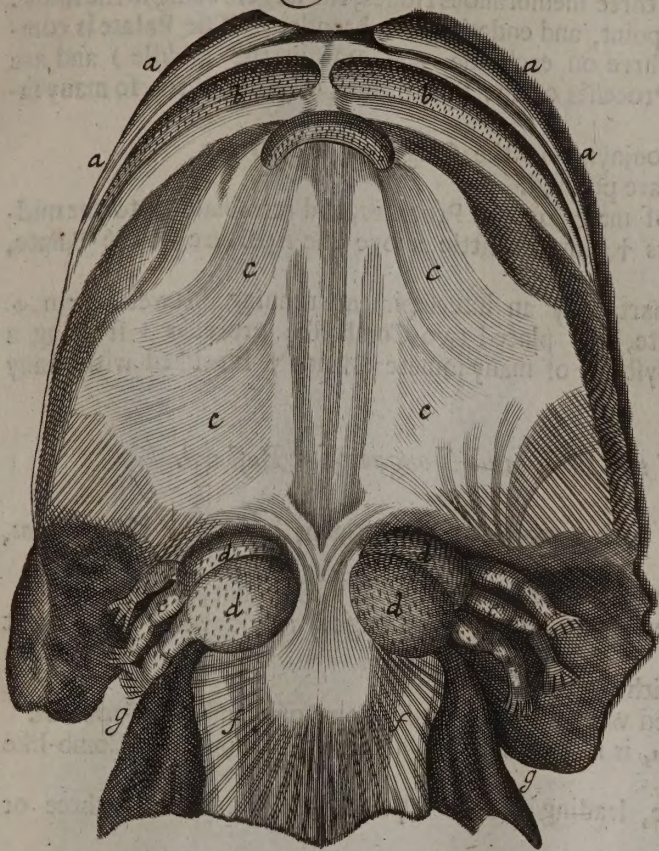


Fig. 2.

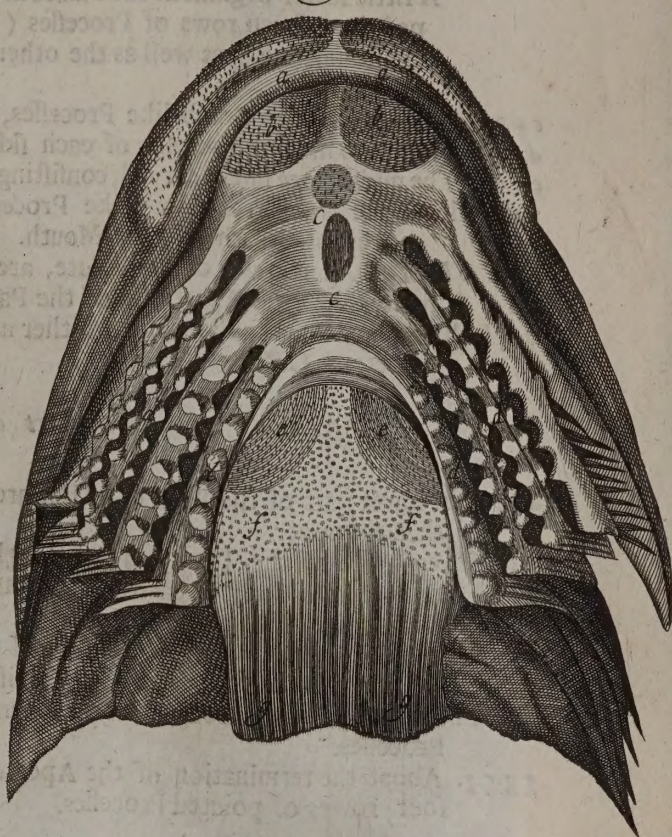


Fig. 3.

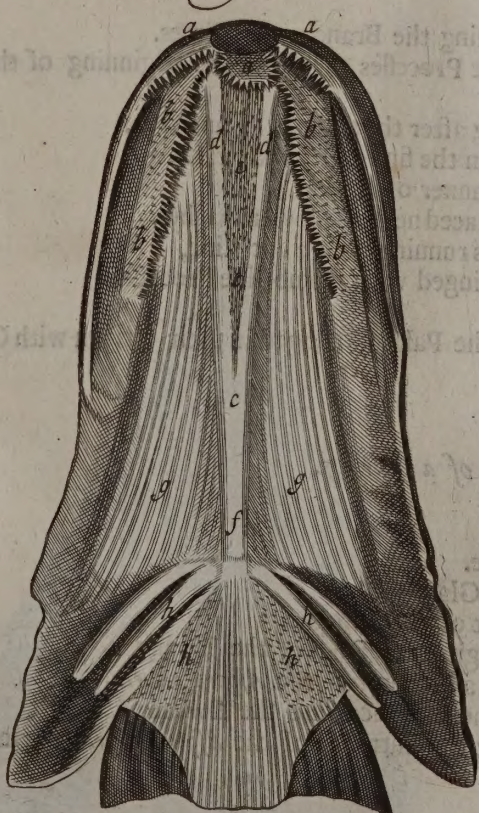
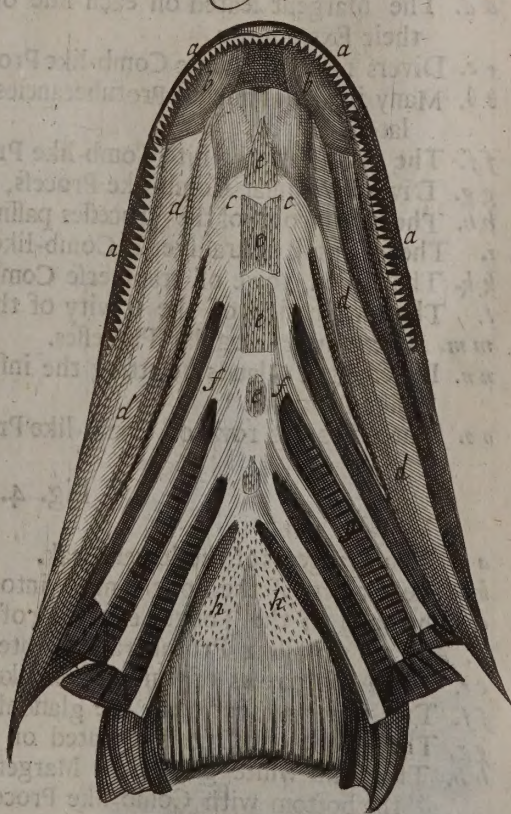


Fig. 4.



Tab. VI. Fig. 1. *Of the Palate of the upper part of the Beak of a Bustard.*

- a.** The upper region of the Beak of a Bustard is hooked in its Origen, and hath on each side a sharp edge, which in pointed beaked Fowls, serveth instead of Teeth.
- bb b.** On the beginning of the inside are lodged three membranous ridges, the largest being in the midst. A little lower beginneth the Palate in a point, and endeth much broader. The Palate is composed of seven rows of Processes (Three on each side, and One in the middle) and are (as I imagine) as well as the other Processes of the Palate and Tongue of Birds, so many salivary Glands.
- cccc.** The outward are Comb-like Processes, conjoynd in the Origen of the Palate.
- dddd.** The two inward Processes of each side are pointed.
- eeee.** The middle are finely carved, consisting of many joyned Processes, and terminated into the middle of the transverse Comb-like Processes + seated a little above the Aperture of the Palate, conveying Breath into the Mouth.
- fgg. hh.** The Apertures + of the Palate, are parted by an interspiment running between them +.
- ii.** A little below the Apertures of the Palate, are placed two Comb-like Processes + fringing a
- kk.** Red glandulous substance, or rather a Systeme of many minute Glands + furnished with many excretory Ducts.

Fig. 2. *Of the lower part of the Beak and Tongue of a Bustard.*

- aa.** The lower part of the Beak of a Bustard, hath a more straight Origen, and more blunt edges, then the upper.
- bb.** On each side of the Tongue is seated a glandulous substance, dressed with miliary Glands.
- cc.** This glandulous Body on each side near the termination of the Tongue, is fringed in its margent with many white pointed Processes.
- dd.** The Tongue near its Origen is endued with a pyramidal Figure.
- e.** The Tongue in its termination is garnished with a Semi-circular rowe of Comb-like Processes.
- ff.** The Fissure, or entrance of the *Aspera arteria*, is fringed on each side with a rowe of Comb-like Processes.
- ggg.** About the termination of the Aperture, leading into the *Aspera Arteria*, are seated three or four rowes of pointed Processes.

Fig. 3. *The Palate of a Turkey.*

- aa.** The Margent seated on each side of the upper Beak, passeth in right lines, without any Saw-like Processes, as in a Wildgoose.
- bb.** The Bones enclosing the Muscular and Glandulous part of the inside of the Mouth.
- cc.** The Cavities relating to the inside of the upper Beak.
- dd.** The Margent seated on each side of the Palate, terminates into Comb-like Processes, fringing their Extremitities.
- ee.** Divers ranks of white Comb-like Processes, resembling the Branches of Trees.
- ff.** Many irregular minute Protuberancies, or Comb-like Processes placed in the beginning of the Palate.
- gg.** The first rank of white Comb-like Processes running after the manner of an Arch.
- hh.** Divers irregular Comb-like Process, seated between the first and lowest rank.
- ii.** The lower rows of the Processes passing after the manner of Arches.
- kk.** The first rank of transverse Comb-like Processes, placed near the lower Arches.
- ll.** The second rowe of transverse Comb-like Processes running in a right Line.
- mm.** The termination of the Cavity of the Nostrils, fringed with Comb-like Processes.
- nn.** The minute irregular Processes.
- oo.** Divers little Glands besetting the inferior part of the Palate, fringed in their Origen with Comb-like Processes.
- pp.** Three straight rows of Comb-like Processes.

Fig. 4. *The Tongue of a Turkey.*

- aa.** The Margents of the lower Beak.
- b.** The Origen of the Tongue made into an acute Cone.
- c.** The body of the Tongue consisting of many minute Glands.
- d.** A round glandulous Protuberance, seated near the root of the Tongue.
- ee.** The Arched rows of white Comb-like Processes fringing the Root of the Tongue.
- ff.** Two Cartilages enclosing the glandulous substance, adjoyning to the *Aspera arteria*.
- gg.** The glandulous Compage seated on each side of the entrance into the *Larynx*.
- hh.** The plain white glandulous Margents (immuring the entrance of the *Aspera arteria*) fringed in the bottom with Comb-like Processes.
- i.** The entrance into the *Aspera arteria*.
- kk.** Two white ranks of transverse Comb-like Processes, fringing the termination of the glandulous substance, encompassing the entrance of the Windpipe.
- ll.** The *Aspera arteria*, consisting of many annular Cartilages, interspersed with many thin Membranes.

Fig. 1.

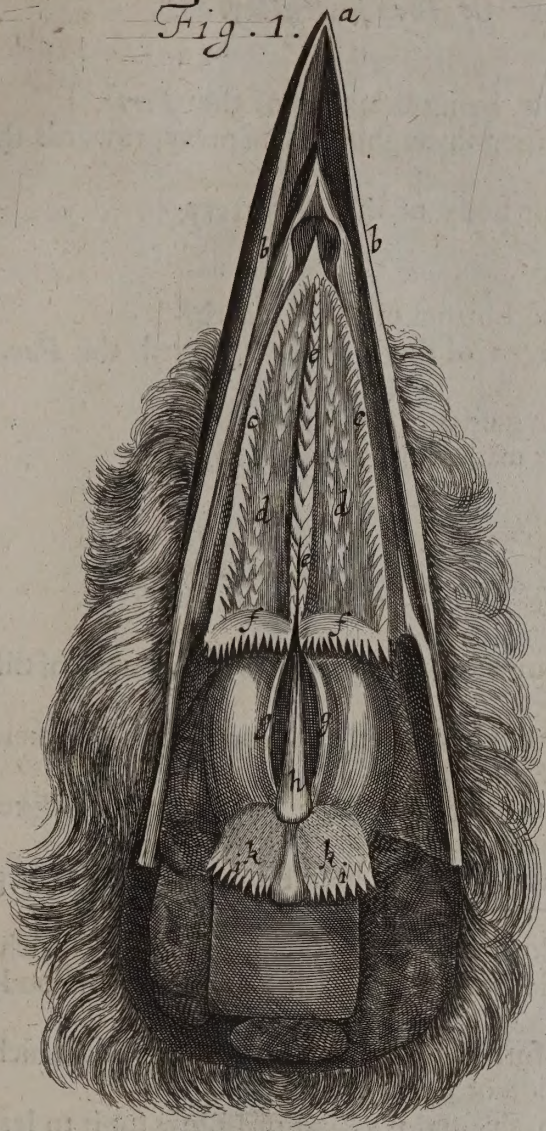
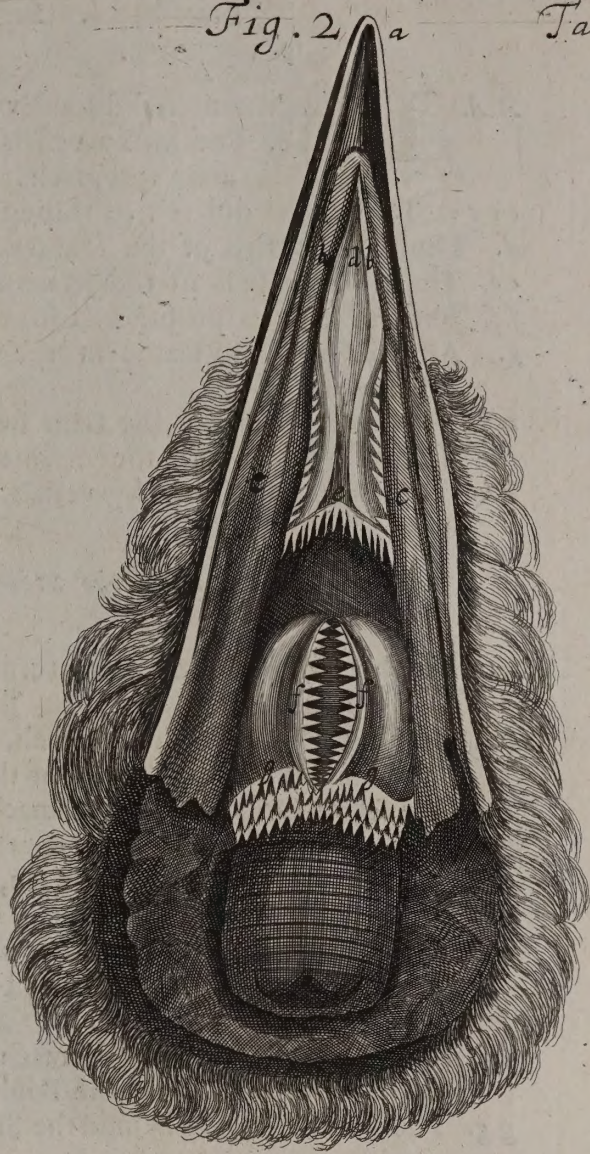


Fig. 2.



Tab. 6.

Fig. 3.

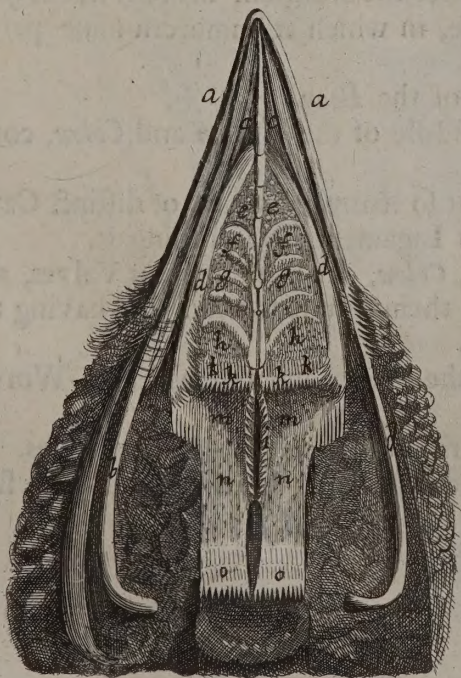
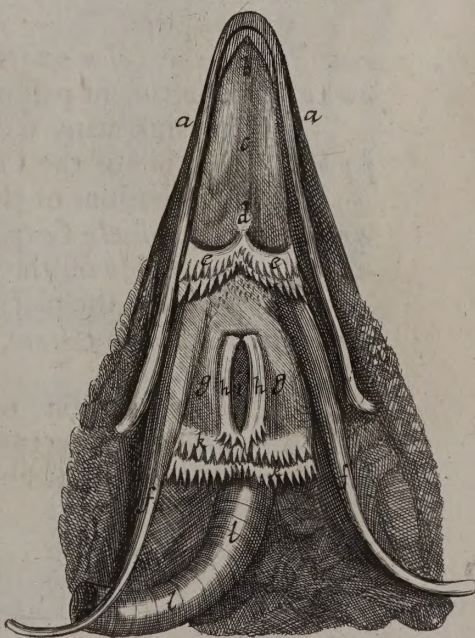


Fig. 4.



Tab. VII. Fig. 1. Of the Mesentery.

- AA.* **T**HE Mesenterick Blood-vessels, being branches of the *Porta*.
bbbb. The Milky-vessels passing through the Mesentery, towards the common receptacle.
cccc. The Nerves distributed through the body of the Mesentery.
d. The Blood-vessels of the *Duodenum*.
ee. The Blood-vessels of the *Jejunum*.
ff. The Sanguiducts propagated from the bottom of the Stomach.
g. An eminent Gland seated in the Origen of the Mesentery, called the *Pancreas* by *Asellius*.
h. The Milky-vessels of the Guts swelling upon a Ligature.
ii. The Milky-vessels of the Mesentery, made turgent by a Ligature.
kk. The Valves in the Milky-vessels.

Fig. 2. Of the Stomach and Guts of a Humane Body.

- a.* The bottom of the Stomach turned upward, to give us the advantage of discerning the *Pancreas*.
bb. The Left Orifice of the Stomach, through which the Meat and Drink is immediately transmitted into the bosom of the Stomach.
cc. The Right Orifice of the Stomach, through which the Chyle, and gross Excrements are conveyed into the Origen of the Guts.
dd. The second Coat of the Stomach, garnished with long Fibres, making their progress the length of the Ventricle.
ee. The third Coat of the Stomach is adorned with transverse Fibres (of which a small prospect is only given in the Left side of the Stomach) encircling the body of the Stomach.
ff. The fourth Coat of the Stomach is furnished with oblique Fibres, of which a small sight may be taken in the Right side of the Ventricle.
gg. The *Pancreas* seated behind the Stomach, and is a kind of Pillow for it to lean upon, and to impart heat unto it.
hh. The Blood-vessels branched on the surface of the second Coat of the Stomach, after the manner of Network.
ii. The *Pancreas* is an aggregate Body, composed of many minute Globules, which are distinct Glands, of various shapes and sizes, encircled with proper Membranes.
kk. The *Ileon*, composed of many circumvolutions, is encompassed by the *Colon*.
lll. Part of the *Colon* creeping cross-ways under the Stomach, maketh five *Anfractus*.
mm. Part of the *Colon* seated in the Right side, in which it immureth some part of the *Ileon*.
nn. Part of the *Colon* guarding the Left side of the *Ileon*.
oooo. The Ligament passing all along the middle of the *Cacum* and *Colon*, contracting them into many Cells.
pppp. The Cells of the *Colon* are nothing but so many peculiar, or distinct Cavities, or Corrugations of the Gut, made by a Ligament, straightning it.
qqqqq. The *Valvula Conniventes* of the *Ileon*, *Colon*, are Semi-circular Valves, affixed to the inside of the Guts, straightning them but half way, and having the other free for the passage of Excrements.
rr. The *Intestinum Cacum*, is appendant to the *Colon*, and resembleth a Worm in Figure.
ssss. The divarications of Blood-vessels, variously enamelling the Intestines.
TT. The *Colon* tending toward the Spleen and Left Kidney, is formed into short circumflexures, resembling the Letter S.

Tab. VIII.

Fig. 1.

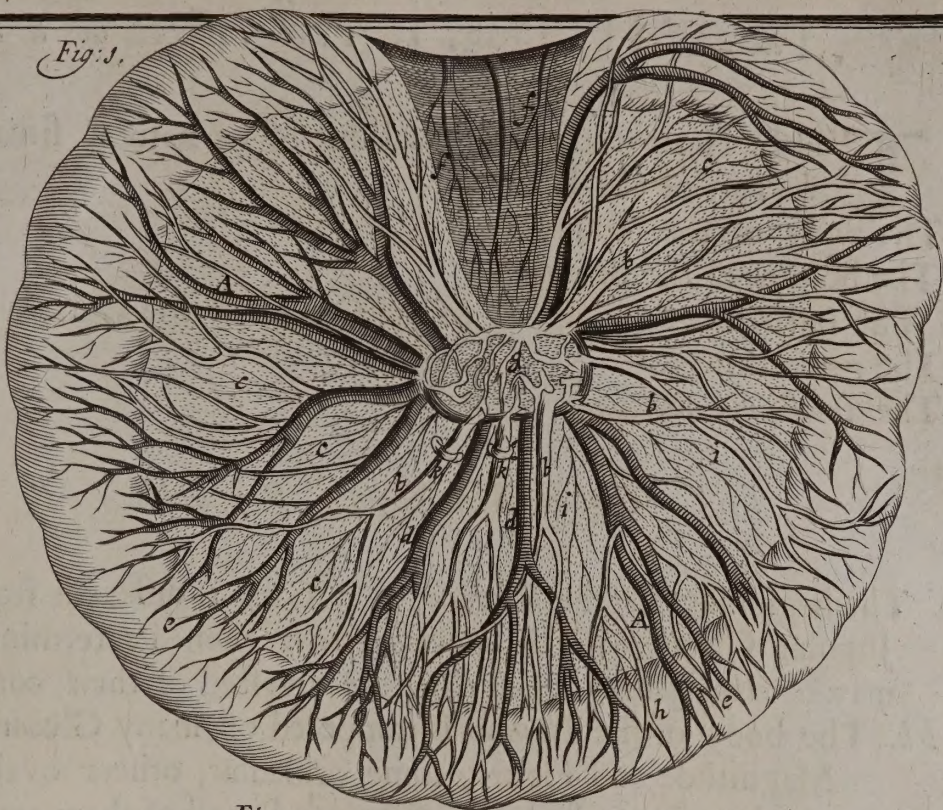
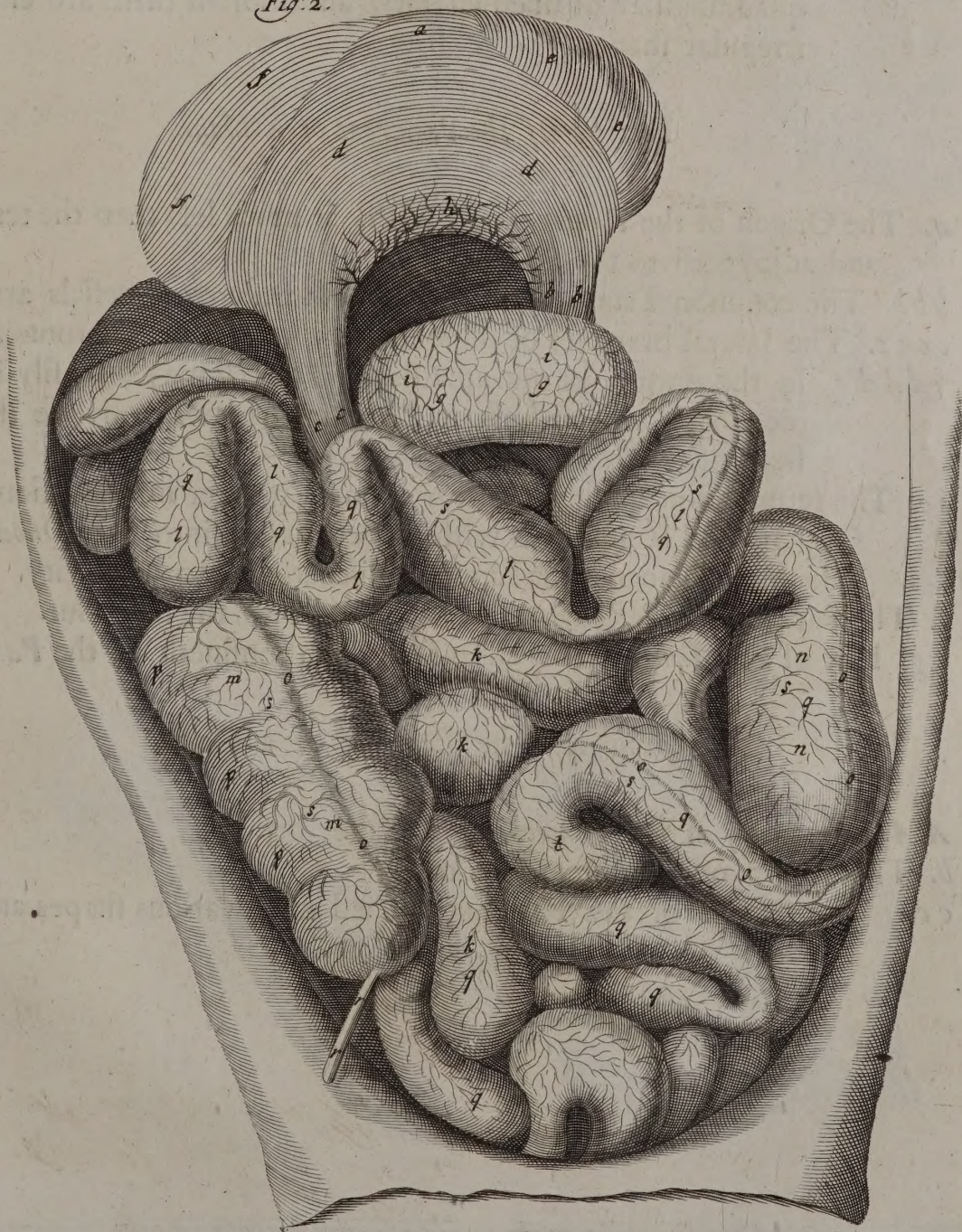


Fig. 2.



Tab. VIII. Fig. 1. *The Viscera of a Fish.*

- a. **T**HE Heart turned upward out of its natural situation.
 b. Part of the Liver.
 c. The body of the Stomach.
 d. The bottom of the Stomach.
 e e. The *Intestinnla Cæca* affixed to the Origen of the Guts.
 f. The great Bowel.
 g. The *Intestinum rectum*.

Fig. 2. *The Thymus of a Calfe.*

- a a. The beginning of the *Thymus* of a Calfe is different from that of the Jugular Glands, and is more narrow then its terminations, which may be clearly seen when they are divested of their common Coat.
 b b b b. The body of the *Thymus* is compoed of many Globules of unequal Magnitude and Figure, some orbicular, others oval, and others quadrangular of unequal sides, and most of them are endued with irregular shapes.

Fig. 3. *Of the Pancreas of a Man.*

- a. The Origen of the *Pancreas* in a Man, is much less then the termination, and adjoyneth to the Spleen.
 b b b. The common Trunk, into which all the excretory vessels are infetted.
 c c c c. The lateral branches of the excretory vessels, whose roots are seated
 † d d d in the numerous minute Glands † which may be easily seen when the Coat is stripped off, and are endued with diverse shapes and sizes.
 e e. The termination of the *Pancreas* is much greater in dimensions then its Origen, and is attended with a Perforation into the *Duodenum*, by which the Pancreatick Liquor is discharged into its Cavity.
 f. The Pancreatick Duct which is implanted into the first Gut.
 g g. Part of the *Duodenum* (cut off) which confineth on the *Pancreas*.

Fig. 4. *The Pancreas of a Calfe.*

- A A. The body of the *Pancreas* of a Calfe.
 b. The Trunk of the Artery cut off.
 c c c. The Glands of the *Pancreas*, endued with various shapes and sizes.

Fig: 1.

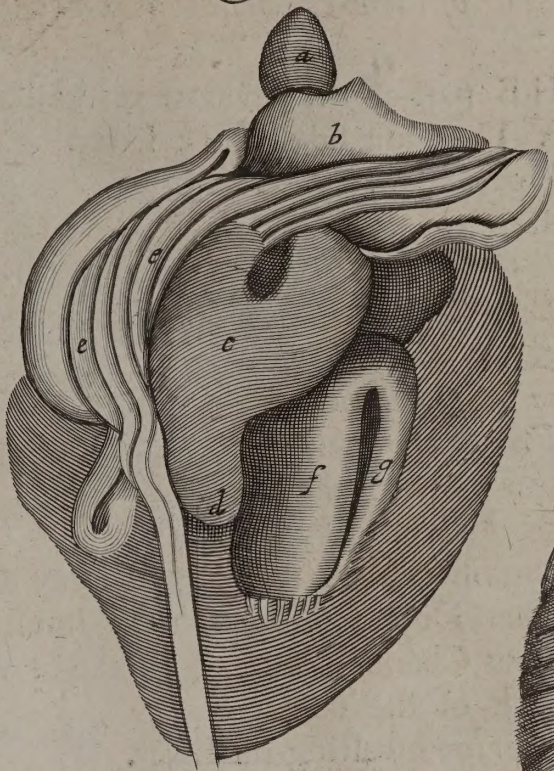


Fig: 2.

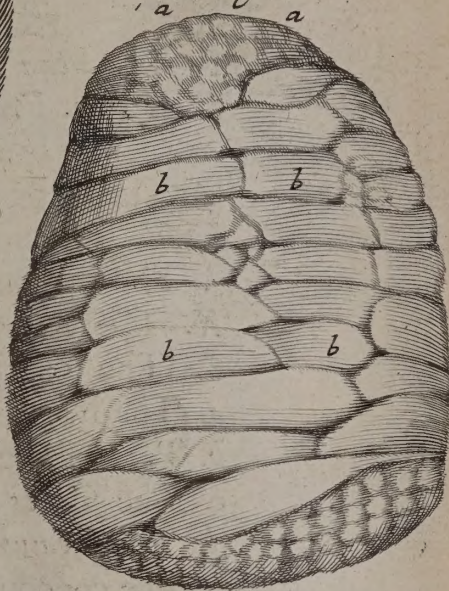
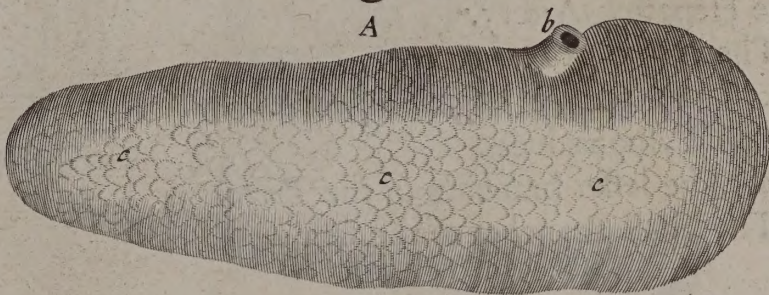
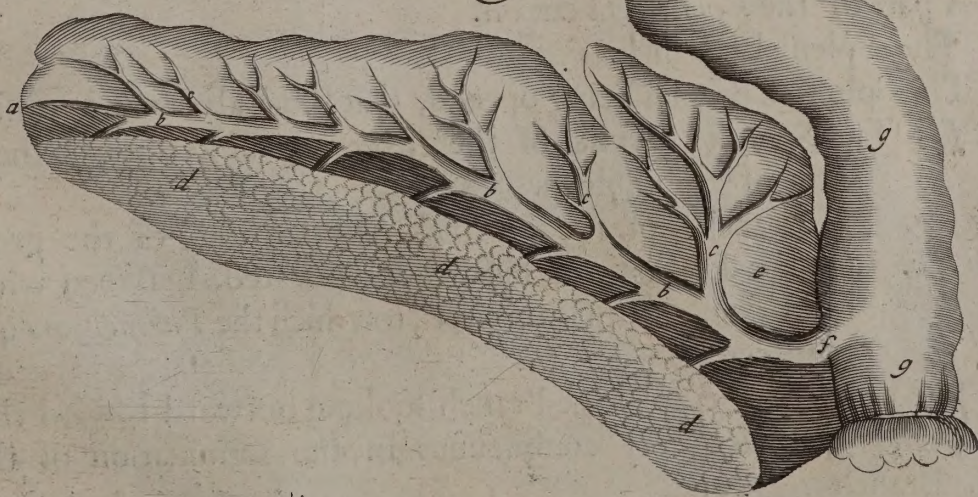


Fig: 4.



A

Fig: 3.



Tab. IX. Fig. 1. In which is represented the Concave part
of the excarnated Liver of Man.

- A.** **T**HE part of the Liver next the Back.
B. The right side of the Liver.
C. The fore-part of it.
D. The Left Side.
E. The *Vena Cava*, where it passeth through the Midriffe.
E. 1. E. 2. E. 3. The three first Branches of the *Cava*, distributed through the whole Liver.
F. The *Vena Porta* turned back and upward.
F. 1. F. 2. F. 3. F. 4. Four branches of the *Porta* dispersed into the lower fourth part of the Liver.
G. The Bladder of Gall.
H H. The umbilical Vein, degenerated into a Ligament.
I. The common Duct leading into the Intestines.
K. The venous Channel, serving instead of a Ligament.
L. The Trunk of the *Cava*.
a. The Membrane investing the Liver.
b. Part of the Midriffe.
c. The *Porus Biliaris*.
d. The *Meatus Cysticus*.
e. The concurrence of these excretory Vessels.
f. The Hepatick Artery.
g. o. The Hepatick Nerves.
pppp. The common *Capsula* opened.
qq. The Lymphæducts.
mmm. The lesser branches of the *Porta*.
nn. The small Branches of the *Cava*.

Fig. 2. Of a Man's Spleen opened.

- aaaa.** The substance of the Spleen.
bb. The Tunicle being Dissected, and Inverted, that the progress of the Blood-vessels and nervous Plexes may be the better discovered.
c. A part of the *Vena Porta* cut off.
d. The Splenick Branch.
e. The Splenick Branch being opened, that the Valve may be discerned.
ffff. The Splenick Trunk of the Artery, passing through the whole substance of the Spleen.
gggg. The Branches of the Splenick Artery arising of the great Trunk.
hhhh. Nervous Fibrils wonderfully complicated, between which the Arteries do make their progress, to which the *Parenchyma* of the Spleen is affixed.
i. The Valve of the Splenick Branch looking outward toward the *Porta*.
k. Many holes are very conspicuous in the termination of the Splenick Branch.
l. Nerves passing by sides of the Splenick Artery.

Fig. 1.

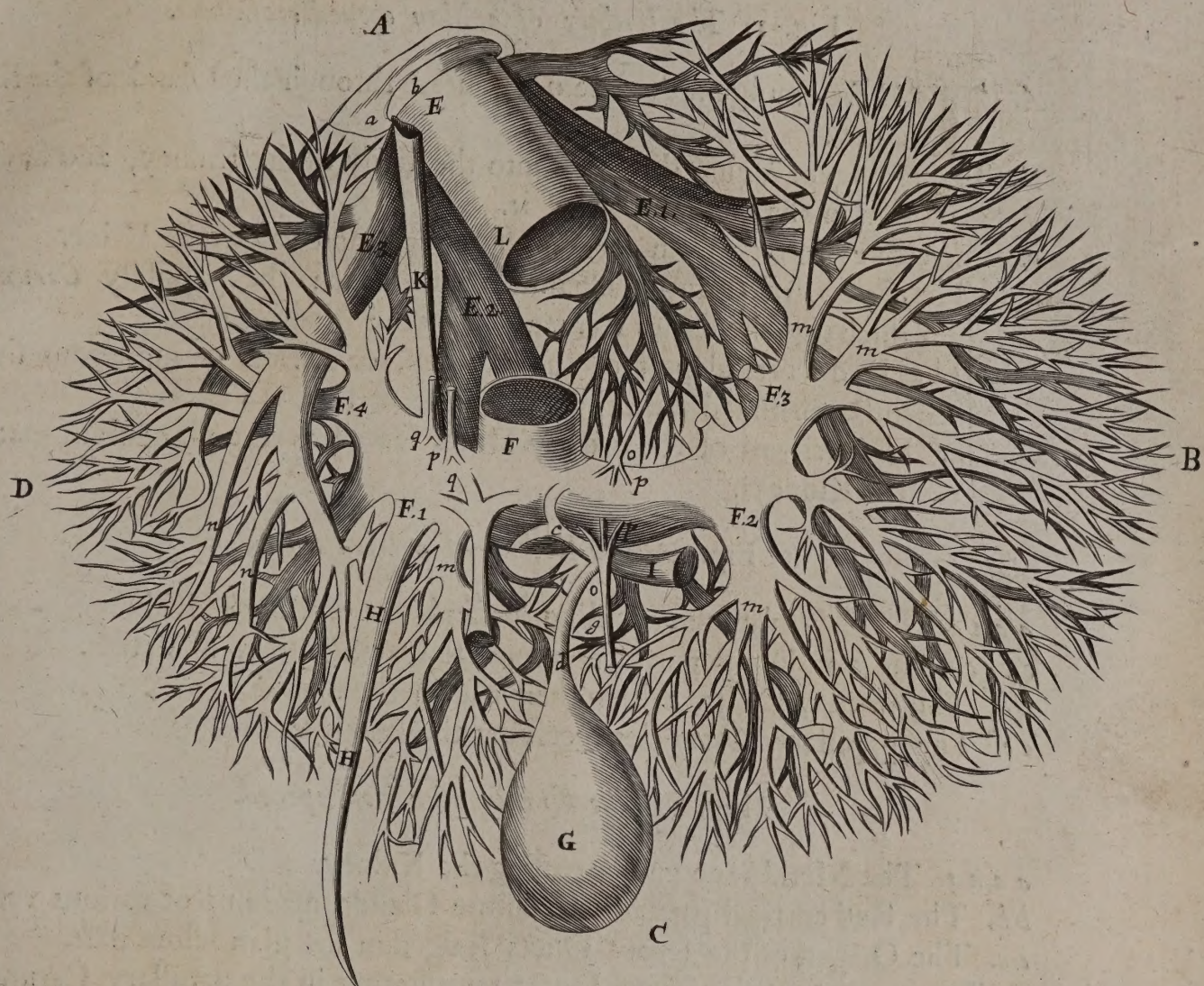


Fig. 2.



Tab. X. Of the Kidneys of several Animals.

Fig. 1. The Kidney of a Man opened crossways.

- A. **T**HE emulgent Arterie distributed through the Glands of the Kidney.
- B. The emulgent Vein, dispersed into the body of the Kidney, and having its root in the cortical part of it.
- c. The Ureter derived from the *Pelvis*, or common Cistern of Urine.
- dd. The *Pelvis*, or common Channel, into which the papillary Caruncles do discharge the serous Recrements of the Blood.
- bb. The Red cortical part of the Kidney, consisting of numerous small Glands, furnished with the extremities of several Vessels.
- The Origins of the urinary Ducts seated in the glandulous part of the Kidneys.

Fig. 2. The Kidney of a Lion opened.

- aaaa. The Membrane encircling the ambient part of the Kidney.
- cccc. The glandulous part accommodated with variety of Vessels.
- bb. The urinary Ducts, taking their rise in the ambient parts.
- ee. The papillary Caruncles receiving the serous Vessels.

Fig. 3. The Kidney of a Fox opened.

- aaaa. The Membrane encompassing the Kidney.
- bb. The Red cortical part, full of minute Glands, made up of various vessels.
- cc. The Origen of the serous Ducts lodged in the glandulous part.
- d. The progress of the serous Ducts terminating in the papillary Caruncles.
- f. The *Pelvis*, or common Channel, into which the papillary Caruncles discharge their Liquor.

Fig. 4. Of the Kidney of a Man excarnated according to Bellinus,

The halfe of a humane Kidney, freed from the *Pelvis*, and many vessels, that the union of the excretory Ducts may be represented.

- aa. The extream Filaments ending near the surface of the Kidney.
- bbb. The meeting of the Renal Ducts, making the papillary Body.
- ccc. The serous drops squeezed out of the extremities of the papillary Ducts.

Fig. 5. Of the Blood-vessels relating to the Kidneys of a Man.

The Blood-vessels running in diverse Mæanders, endued with various shapes.

- aa. The Vessels running in numerous Gyres.
- bb. The wide spaces interceding the Vessels.
- ccc. Certain vermicular Sinus, which are conceived to encircle the said spaces.

Fig. 6. The Kidneys of a Calfe.

- aaaa. The Globules of various shapes and sizes, which are as it were so many Kidneys, consisting of many small Glands, and diverse kinds of Vessels.
- bbb. The Blood-vessels shading the surface of the Globules.

Fig. 1.

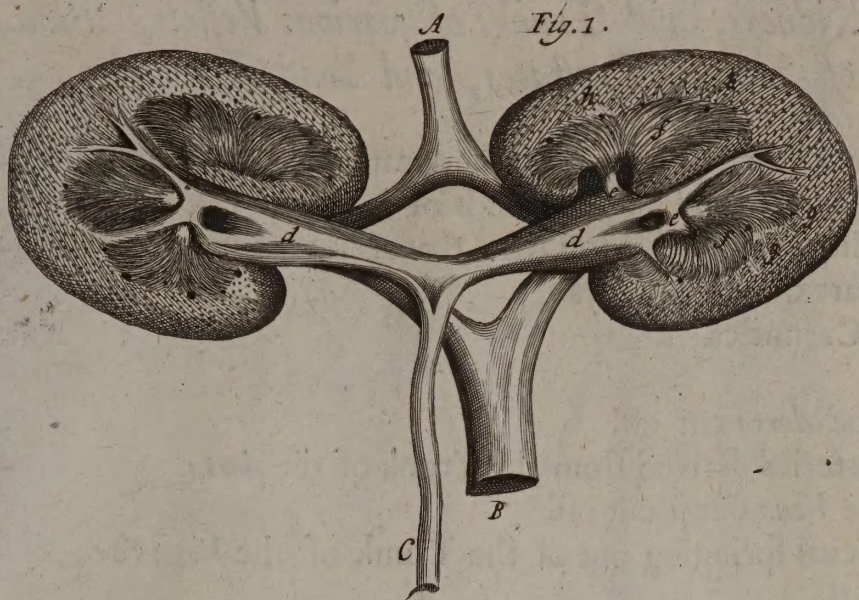


Fig. 2.

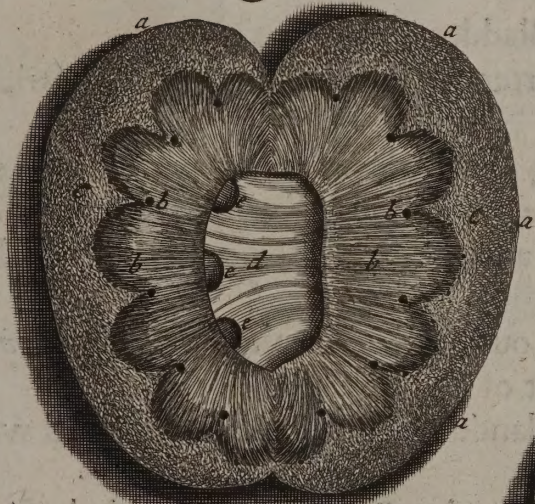


Fig. 4.

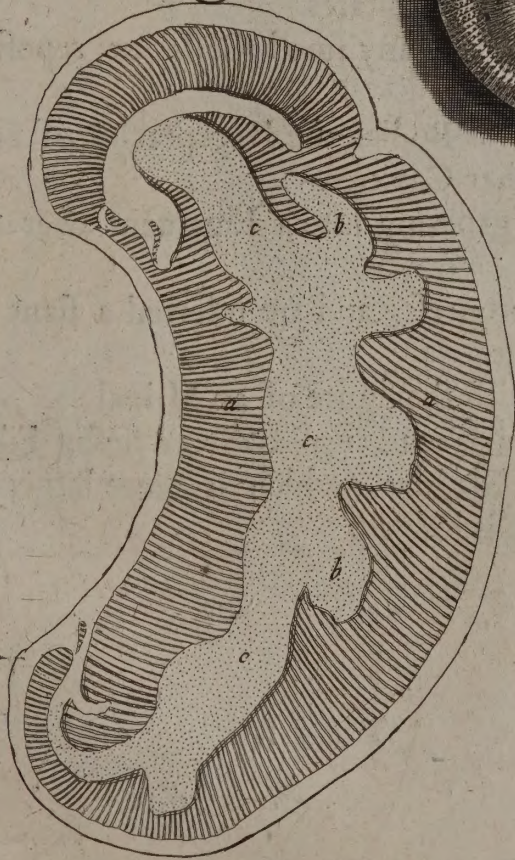


Fig. 3.

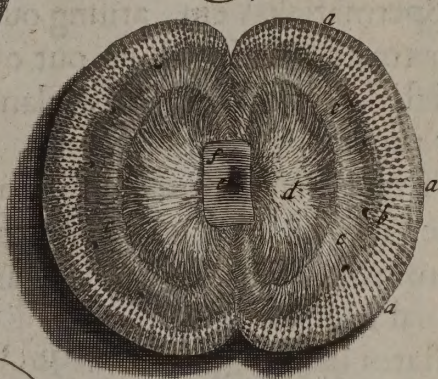


Fig. 6.

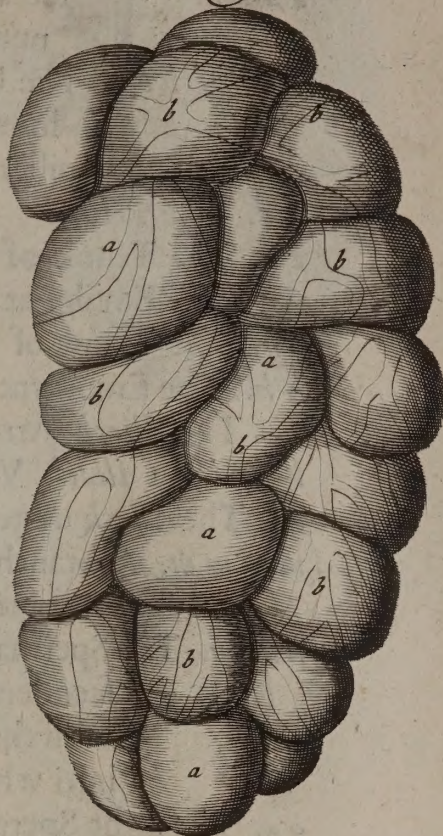
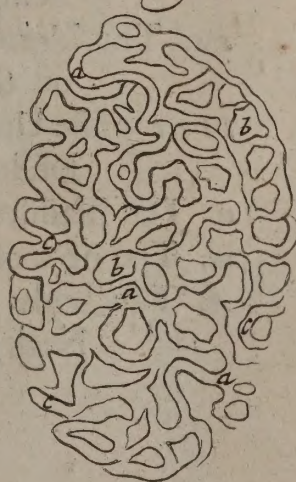


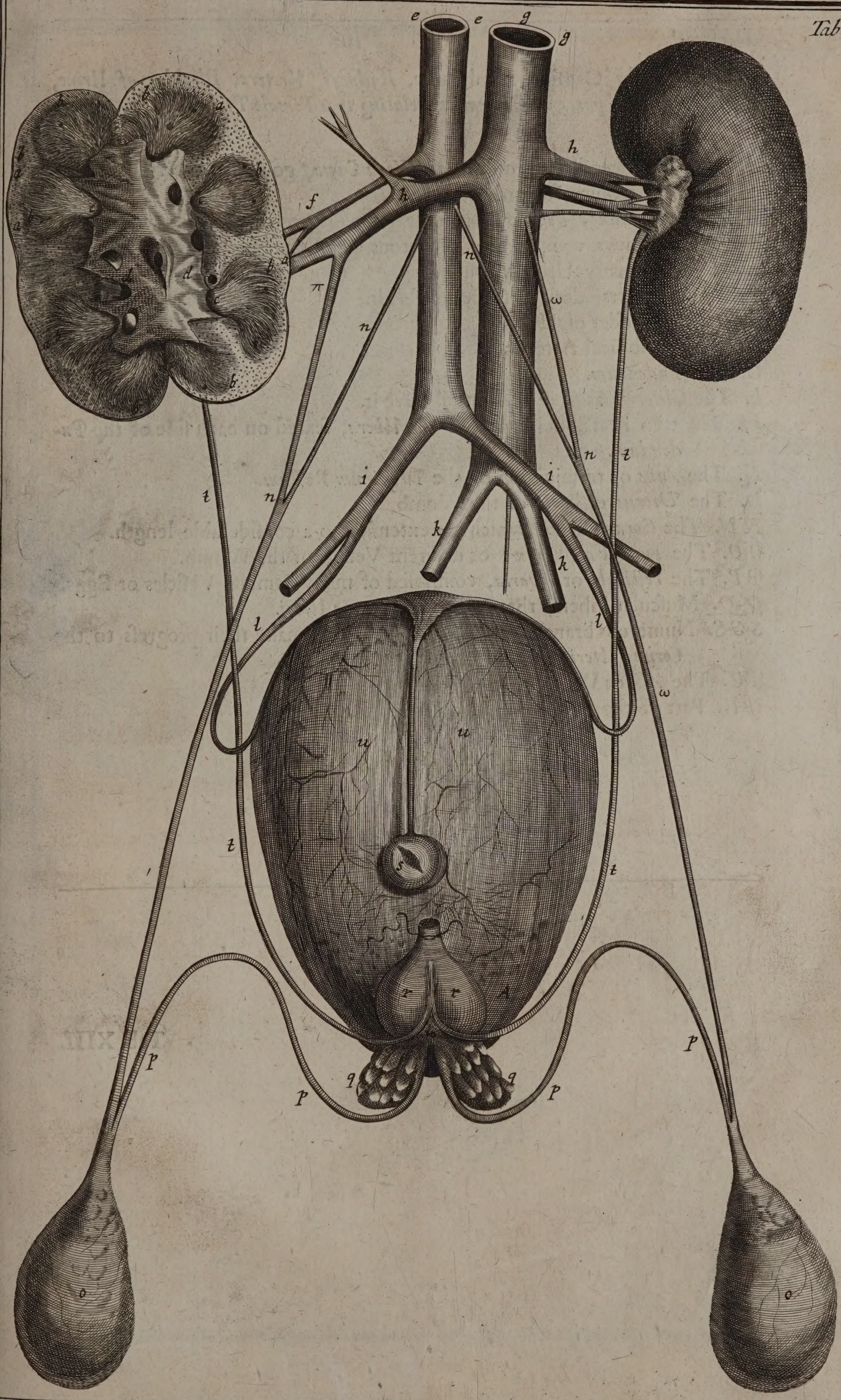
Fig. 5.



Tab. XI. *The Kidneys, and Trunks of various Vessels, Bladder of Urine, Prostates, and Seminal Vesicles.*

- a a a a.* **T**He Cortical part of the Kidney composed of numerous minute Glands, and various kinds of Vessels.
- b b b b b b b.* The Urinary Ducts having their Roots seated in the glandulous part of the Kidneys.
- c c c c.* The Papillary Caruncles.
- d d.* The Pelvis.
- e e.* The Trunk of the *Aorta* cut off.
- f f.* The Emulgent Arteries derived from the Trunk of the *Aorta*.
- g g.* The Trunk of the *Vena Cava* cut off.
- h h.* The Emulgent Veins springing out of the Trunk of the *Vena Cava*.
- i i.* The *Iliack* Arteries.
- k k.* The *Iliack* Veins.
- l l.* The *Iliack* Arteries passing to the Bladder.
- m m m m.* A branch of the Emulgent Artery going to the Seminal Ventricles and Prostates.
- n n n n.* The Spermatick Arteries coming out of the anterior part of the descendent Trunk of the *Aorta*, unite themselves after some space, with the Spermatick Veins, and then pass down to the Testicles, into which they are inserted.
- o o.* The right Spermatick Vein, arising out of the Trunk of the *Vena Cava*.
- π π.* The left Spermatick Vein arising out of the Emulgent Vein.
- q o o o.* The Testicles, consisting of a glandulous substance interspersed with great variety of Vessels.
- p p p p.* The deferent Vessels, passing from the Prostates or Epididymides to the Seminal Vesicles, and Prostates.
- q q q q.* The Seminal Vesicles being so many small Cells, or repositories of Seminal Liquor.
- r r r.* The Prostates being glandulous Bodies, the Receptacles of Semen, as being endued with peculiar Cavities.
- s s.* The *Urachus* contracted, and growing into a Ligament after the birth of the Child.
- t t t t.* The Ureters make another progress, and are inserted a slant into the hinder part of the Bladder.
- u.* The Bladder of Urine endued with the figure of an Urinal.
- w.* The neck of the Bladder is fleshy as made up of divers fleshy Fibers.
- A.* The body and bottom of the Bladder (which is more large then the Neck) in which the Urine is lodged.

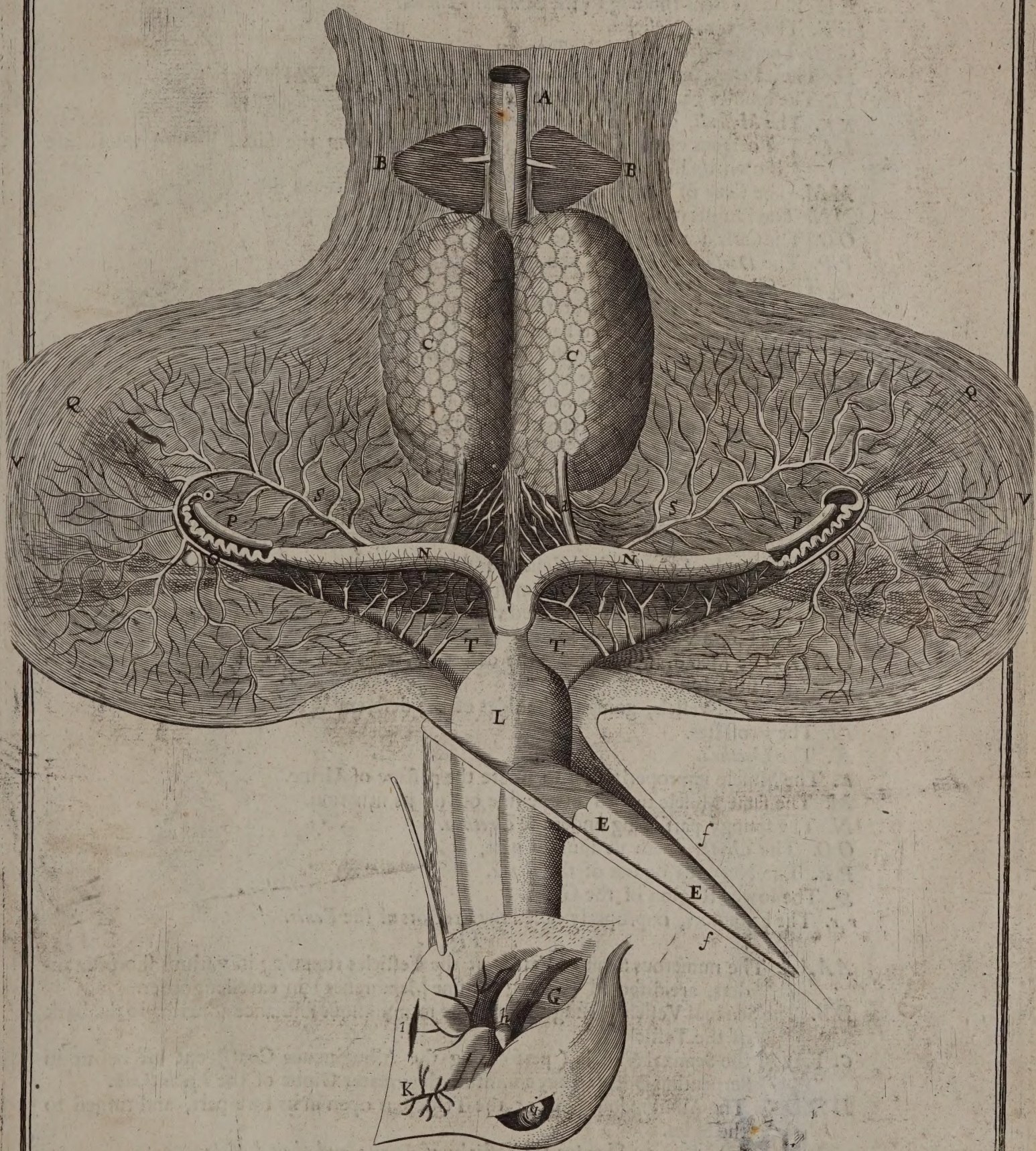
Tab. XII.



Tab. XII. *The Capsulæ Atrabiliaræ, Kidneys, Ureters, Bladder of Urine, and parts of Generation, relating to a Female Porpefs.*

- A. **T**He ascending Trunk of the *Vena Cava*, going up the right side of the Spine toward the Heart.
- B B. The *Glandulæ Renales*, seated near the origins of the Kidneys.
- C C. The Kidneys, composed of numerous Conglomerated Glands, attended with many Urinary Ducts.
- d d. The Ureters, derived from the *Pelvis*.
- E E. The Bladder of Urine.
- f f. The Umbilical Arteries.
- G. The *Pudendum*.
- b. The *Clitoris*, as *Dan Maior* will have it.
- i i. The two Teats, being part of the *Ubera*, seated on each side of the *Pudendum*.
- K. The *Anus* or termination of the *Intestinum Rectum*.
- L. The *Uterus* or body of the Womb.
- N N. The *Cornua Uteri*, which are extended to a considerable length.
- O O. The *Tubæ Fallopianæ*, or deferent Vessels of the Womb.
- P P. The *Testicula* or *Ovaria*, composed of many Seminal Vesicles or Eggs.
- Q Q. Muscular Fibers, that go to the *Cornua Uteri*.
- S S S. Numerous branches of Blood-vessels, that make their progress to the *Cornua Uteri*, *Ovaria*, &c.
- T T. The *Alæ* or Wings of the Womb.
- U U. Part of the *Peritonæum*, or Rim of the Belly.
-

Tab. XIII.



Tab. XIII. Fig. 1. The Organs of Generation relating to Man.

- A.** The fore-part of the Bladder of Urine.
B. The neck of the Bladder.
CC. Part of the Ureters.
DD. Part of the deferent Vessels carrying Seminal Liquor to the Vesicles.
EE. Blood-vessels running to the Seminal Vesicles.
FF. The Seminal Vesicles.
GG. The fore-part of the Prostates.
H. The *Urethra* or passage of Urine, adjoyning to its spongy part.
II. The spongy part of the passage of Urine.
KK. The *Musculi*, called *Erectores Penis*.
LL. The origins of the Nervous Bodies (severed from the Share-bones) which are blown up like Bellows, when the *Penis* is erected.
MM. The *Cutis* of the *Penis* being opened, is turned to each side.
NN. The Duplication of the *Cutis*, which maketh the Prepuce.
OO. The *Cutis* seated behind the *Glans*.
PP. The *Dorsum* or Back of the *Penis*.
Q. The *Glans* of the *Penis*.
R. The Urinary passage, perforated in the fore-part of the *Glans*.
SS. Nerves running upon the Back of the *Penis*.
TT. Arteries divaricated upon the *Dorsum Penis*.
U. The *Corpora Nervosa* being united.
WW. Two Veins uniting run with a great Trunk upon the back of the *Penis*.
X. A Vein opened that the Valves may be discovered.

Fig. 2.

- A.** Part of the deferent Vessels, endued with a thick substance, and small Cavity.
B. Part of the deferent Vessels, endued with a thin substance, and large Cavity.
CC. The Extremities of the deferent Vessels inserted with a small hole into the Seminal Vesicles.
DD. The neck of the Seminal Vesicles is divided into two parts by the interposition of a Membrane, to keep the Semen of one side from mixing with that of the other.
EEEE. The Seminal Vesicles distended with Wind, that their Meanders may be plainly seen.
FF. The Blood-vessels going to the Seminal Vesicles.
GGG. The Membranes keeping the deferent Vessels and Seminal Vesicles in their due situation.
hh. The Blood-vessels, going to the sides of the deferent Vessels.
II. The Prostates.
K. The *Urethra*.
L. The Muscle improperly said to dilate the passage of Urine.
M. The same Muscle turned on one side out of its situation.
N. The spongy part lying under the *Urethra*.
OO. The *Urethra* with its spongy part.
PP. The Nervous Bodies of the *Penis*.
Q. The lower Region of the *Glans*.
rr. The Extensors, improperly called the Erectors of the *Penis*.

Fig. 3.

- AAAA.** The numerous Seminal Vessels of the Testicles running in various short Meanders, are disposed (among the fine Membranes) in excellent order.
BB. The Seminal Vessels passing through the membranous substance adhering to the back of the Testicle.
C. Part of the Seminal Vessels (perforating the Albugineous Coat) cut off before in Serpentine Ducts; they constitute the greater Globe of the *Epididymis*.
DDDD. The Albugineous Coat of the Testicle is open in its fore-part, and turned to the Sides.

Fig. 4. Shewing the Testicles of Brutes and their Vesicles.

- A.** The Preparing Vessels cut off.
B. The confused posture of the Preparing Vessels.
C. The branches of the Preparing Vessels tending to the *Epididymis*.
DD. The greatest branch of the Preparing Artery, going through the body of the Testicle.
EE. The ramification of Preparing Veins.
F. A Dogs Testicle full of Seminal Matter.
G. The greater Globe of *Epididymis* turgid with Semen.
H. The lesser Globe of the *Epididymis* distended with equality of Genital Liquor.
I. The termination of the *Epididymis*, or the beginning of the deferent Vessel.
K. The deferent Vessel having a Ligature, that the Seminal Vessels may be more clearly discerned.

Fig. 3.

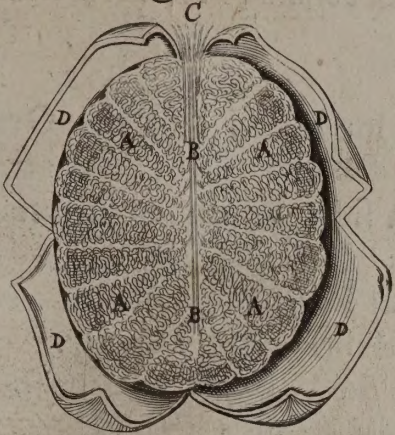


Fig. 4.



Fig. 1.

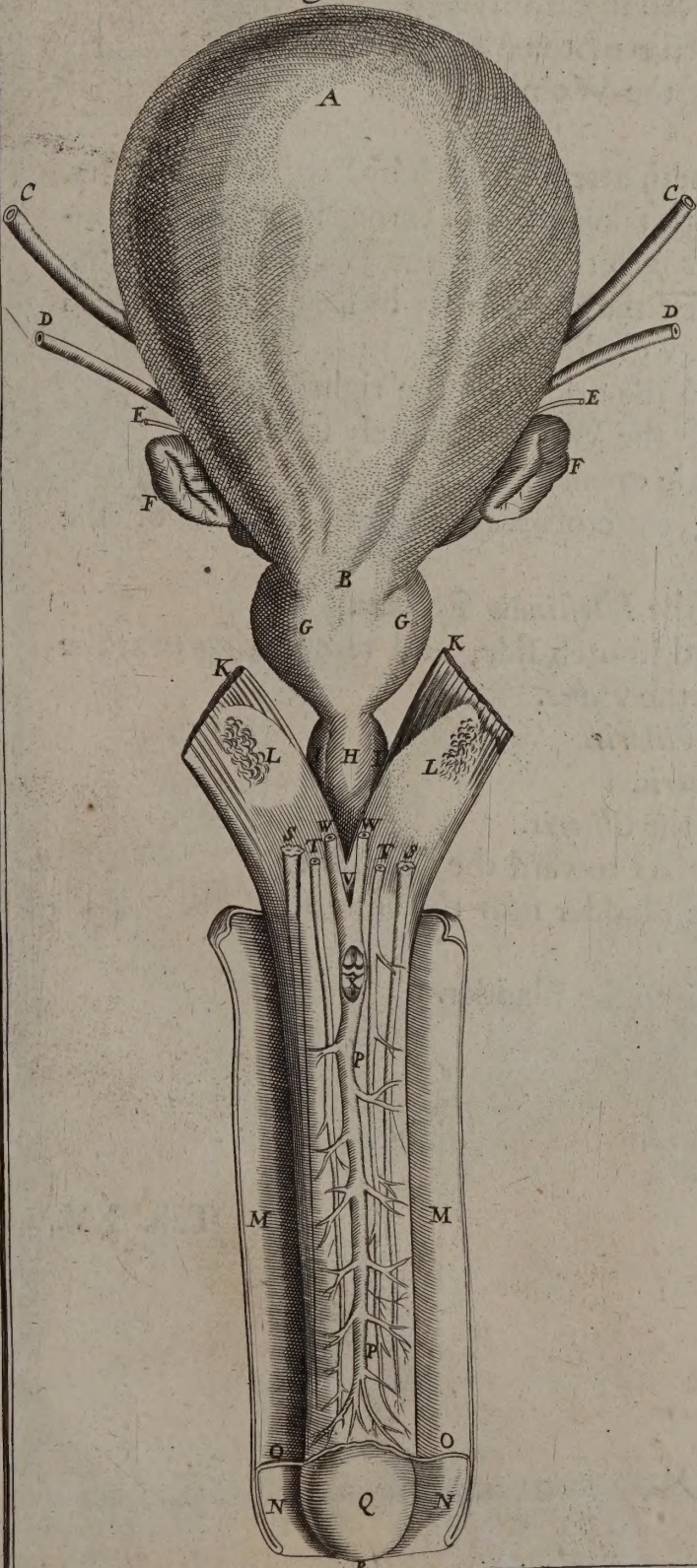
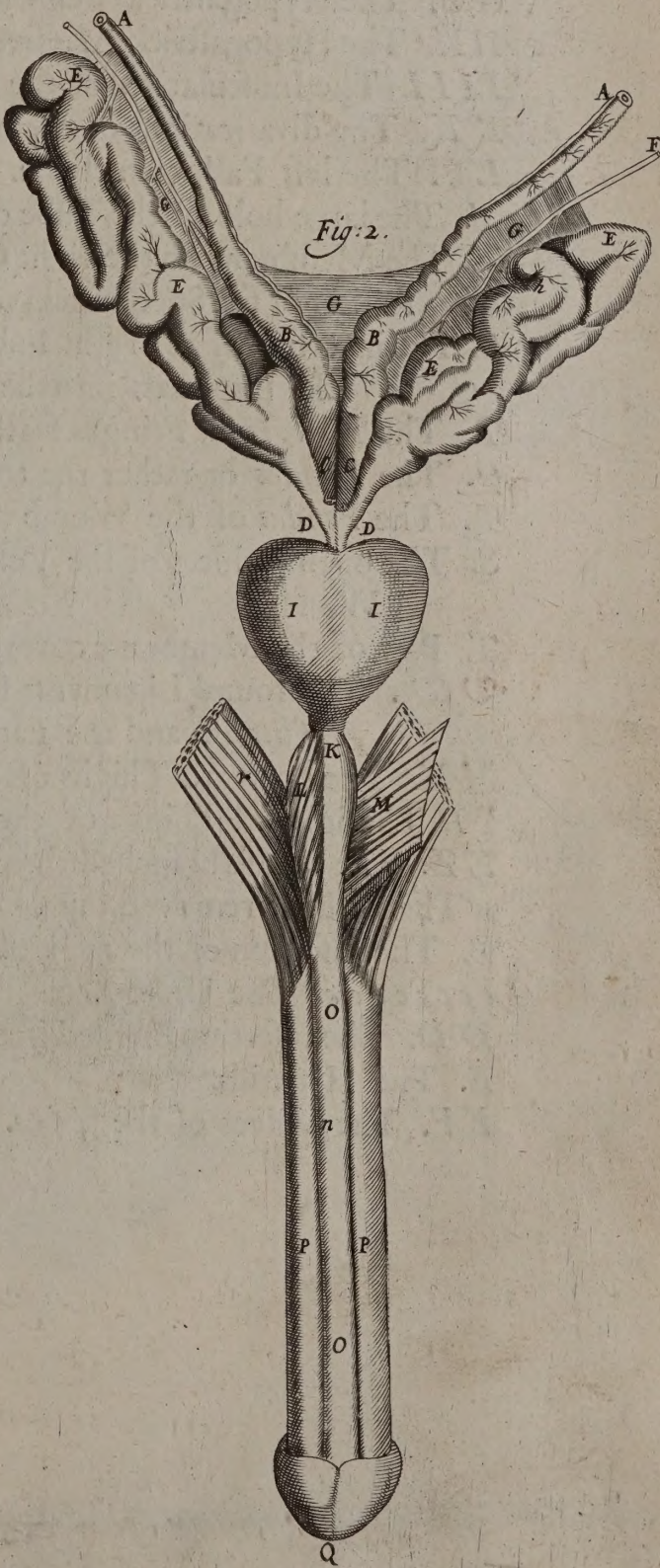
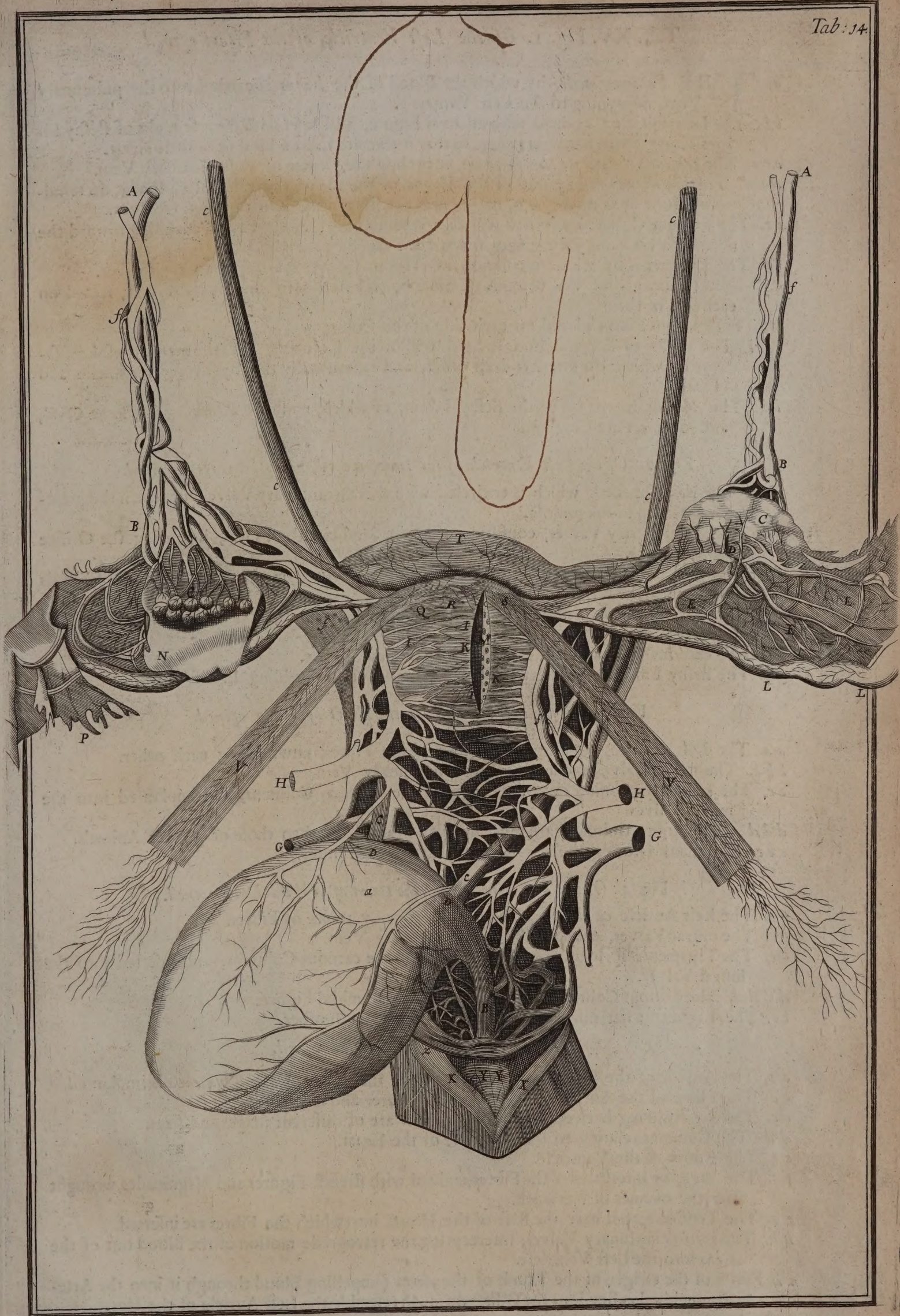


Fig. 2.



Tab. XIV. *The Uterus of a Virgin, according to Learned Swammerdam.*

- A A.* **T**He Spermatick Vessels of each side, implanted into the Ovary, Tube, and Body of the *Uterus*.
- B B.* The Preparing Veins and Arteries of each side, which constitute the Pyramidal body.
- C.* The left Testicle or Ovary with its transparent Eggs.
- D.* The Veins and Spermatick Arteries branched through the Ovary.
- EEE.* The Membranous Ligament (resembling the Wing of a Bat) through which the Spermatick-vessels are carried into the Tube.
- ffff.* The union of the Hypogastrick and Preparing-vessels, climbing up the sides of the Womb under the Tube and round Ligament.
- G G.* The Hypogastrick Veins seated in each side.
- HH.* The Hypogastrick Arteries placed in each side.
- IIII.* The Inosculations of the Arteries of the Womb.
- KK.* The divarications of Veins of the Womb.
- LL.* The left Fallopian Tube.
- M.* The large hole of the Tube opened, attended with its *Fimbriae* or Fringes.
- N.* The Membrane of the right Ovary taken off and turned back, that the insertion of the Spermatick-vessels into the Ovary and Eggs, may be seen.
- O.* The inversion of the right Tube that the Cavity may be seen, through which the Eggs pass into the Body of the Womb.
- P.* The *Fimbriae* or Fringes seated in the origin of the right Tube.
- Q.* The *Fundus* or rather the top of the Womb obscurely swelling.
- R.* The *Fundus* of the Womb a little opened.
- S.* The open Orifices of the Vessels, cut cross-ways in the substance of the Womb.
- T.* Part of the Membrane covering the *Intestinum Rectum*.
- V V.* The round Ligaments seated in each side, and terminating near the *Clitoris*, and the Fat of the *Pubes*.
- XX.* The outward Thighs of the *Clitoris*.
- YY.* The inward Thighs of the *Clitoris*.
- ZZ.* The Vessels branched through the *Clitoris*.
- a.* The Bladder removed out of its place toward the right side.
- B.* The insertion of the neck of the Bladder near the *Clitoris*.
- ccccccc.* The Ureters.
- D D.* The insertion of the Ureter into the Bladder.
- E.* The Hydatids.
- F F.* The Valves of the Veins.



Tab. XV. Fig. 1. *Of the Left Ventricle of the Heart opened*

- a.* **T**HE *Foramen ovale*, by which the Blood of the *Fœtus* is carried into the pulmonary Vein, adjoining to the Left Ventricle.
- bb.* The Left Auricle is endued with an oval Figure, and beset with diverse ranks of fleshy Fibres, lodged one above another, so that it seemeth to be a kind of a little Heart.
- ccc.* The mitral Valves, or Membraness encircling the Orifice of the pulmonary Vein.
- ddd.* The Ligaments arising out of the Heads of the carnous pyramidal Columns, do terminate into two or three, or more branches, implanted into the mitral Valves.
- ee.* The carnous Columns adorned with a pyramidal Figure, their Bases enclining toward the mitral Valves, and their Cones toward the Cone of the Heart.
- ff.* The Ligaments by whose mediation the carnous Columns are tied to each other.
- gg.* The Ligaments of the carnous Columns, inserted into the fleshy Fibres, seated on each side of them.
- hh.* The carnous Fibres placed on each side of the Columns.
- iii.* The ranks of fleshy Fibres, lodged within the Columns, after the manner of Lattise-work, which do intersect each other, and are mutually tied by strong Ligaments and Fibres.
- kk.* The *Area* or Interstices of the fleshy Fibres, of which, most are Rhomboides, some Oval, and others Parallelograms.

Fig. 2. *Of the Left Ventricle of the Heart opened, and other ways described.*

- aaa.* The *Aorta* opened, which is encircled with three semi-lunary Valves, of which the greatest is placed in the middle.
- bbb.* The Semi-lunary Valves, consisting of many Semi-circular Fibres, immuring the Orifice of the *Aorta*.
- ddd.* The Membranes belonging to the Semi-lunary Valves, made up of many right Fibrils filling up the surface of the Valves.
- eee.* The Ligaments sprouting out of the carnous Columns, and inserted into the mitral Valves.
- ff.* The carnous Columns endued with a pyramidal Figure.
- gg.* The fleshy Fibres seated between the Columns, and resembling Lattise-work.

Fig. 3. *Of the Left Ventricle of the Heart of a Pig opened.*

- aa.* The Left Auricle, consisting of many ranks of Fibres, enwrapping each other.
- bbb.* The mitral Valves encompassing the pulmonary Vein.
- cc.* The Ligaments arising out of the top of the carnous Columns, and implanted into the mitral Valves.
- ddd.* The carnous Columns are more small and numerous then those of greater Animals.
- eee.* Ligaments fastning the various Columns to each other.

Fig. 4. *Of the Left Ventricle of the Heart of a Wild-Duck opened.*

- aa.* The Left Auricle of the Heart composed of many ranks of Fibres.
- bb.* The mitral Valves, encompassing the pulmonary Vein.
- cc.* The Ligaments springing out of the heads of the carnous Columns, and inserted into the mitral Valves.
- ddd.* The carnous Columns beautified with a pyramidal Figure.
- ee.* The Ligaments fastening the carnous Columns to each other.

Fig. 5. *The Heart of a Salmon opened.*

- aa.* The Auricle of the Heart opened, into which the orifice of the *Vena cava* is implanted.
- bb.* The Fibres of the Auricle propagated into greater and lesser Branches.
- cc.* The *Area* running between the Fibres, which are of different shapes and sizes.
- dd.* The Columns relating to the Ventricle of the Heart.
- ee.* The Fibres of the Ventricle.
- ff.* The *Area*, or Interstices of the Fibres, endued with diverse Figures and Magnitudes, wrought after the manner of Network.
- gg.* The Tendon seated near the Base of the Heart, into which the Fibres are inserted.
- hh.* The two Semi-lunary Valves, intercepting the retrograde motion of the Blood out of the *Aorta* into the Left Ventricle.
- ii.* Fibres of the Origen of the Trunk of the *Aorta* (impelling Blood through it into the Arterial branches, leading into the Gills,) do much resemble the Left Auricle of the Heart.

Fig: 1.

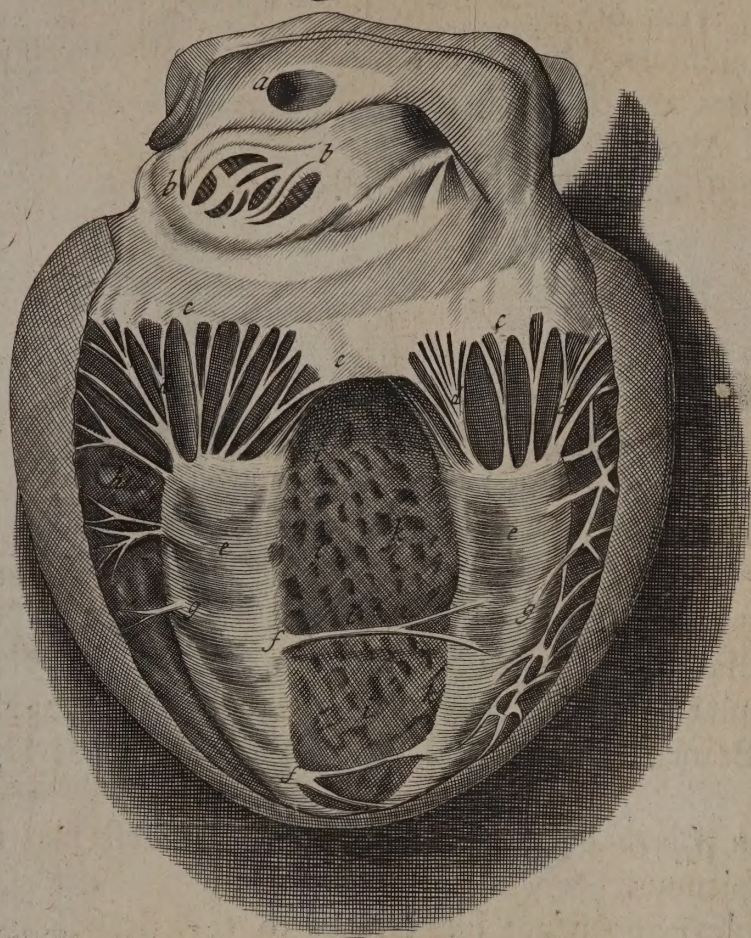


Fig 2.

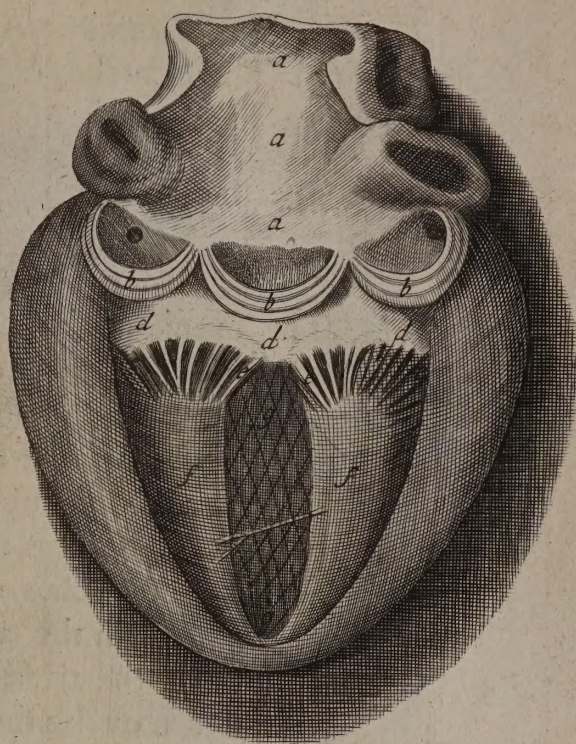


Fig: 3.

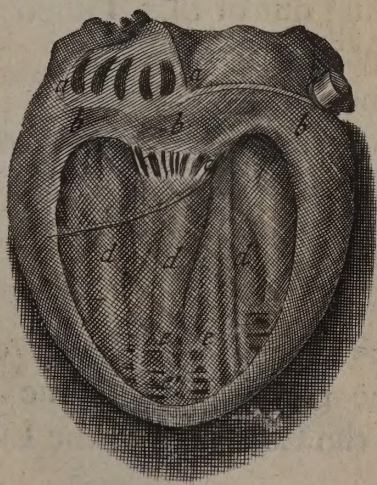


Fig: 4

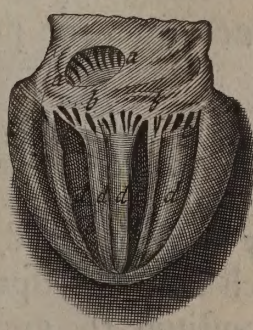
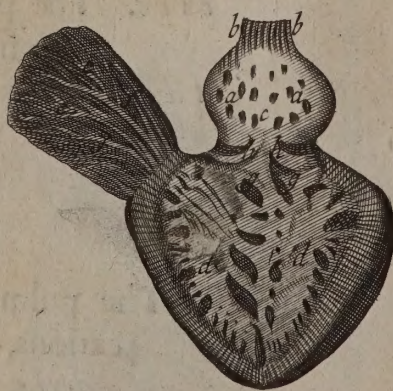


Fig: 5



Tab. XVI. Fig. 1.

- A A A A.* **H** Alfe a Lobe of the Lungs of a Man.
bb. The Trunk of the Pulmonary Artery.
c. A hole where the Artery is cut off.
dd. The Branches of the pulmonary Artery cut off
eee. The Trunks of Arteries, out of which many Branches do sprout.
ffff. The Branches of the Artery.
gggg. The Branches of the Bronchial Artery cut off.

Fig. 2.

- A.* The Trunk of the pulmonary Artery cut off.
B B B. The lower part of the Artery opened by Dissection.
aaa. Little holes leading into diverse Branches of Blood-vessels.
bbb. Diverse muscular Fibres, upon which other circular do rest.
cc. The smaller and upper Trunk of Arteries left unopened, that the annular Cartilages may be discerned.
dddd. The Branches of the *Aspera arteria*, constituting the lesser Lobules, in which the annular Cartilages may be discovered.
eeee. Part of the arterial Branches are opened, that the right muscular Fibres may be seen.
ffff. Some Trunks of the *Aspera arteria* are cut off, that the rest may be rendred more conspicuous.
gggg. The secondary Lobules, appendant like Grapes to the Branches of Wind-pipe, which may be divided into more small Lobules, whose interior Ducts do lead into the vesicular Cells of Air.
hhhh. Blood-vessels shading the surface of these Lobules.

Fig. 3.

- A.* The Trunk of the Wind-pipe.
bbbb. The Branches of the Wind-pipe sprouting out of that Trunk.
cccc. The passages of those Branches, leading into the orbicular Vesicles, which seem to resemble bunches of Grapes.
ddd. Vessels distinct from the pulmonary, covering the *Aspera arteria*.

Fig. 4.

The pulmonary Arteries, and Veins, which do make numerous divariations, which being interspersed with the ramifications of the *Aspera Arteria*, do constitute the greatest part of the Compage of the Lungs.

Tab. XVII.

Fig. 1.

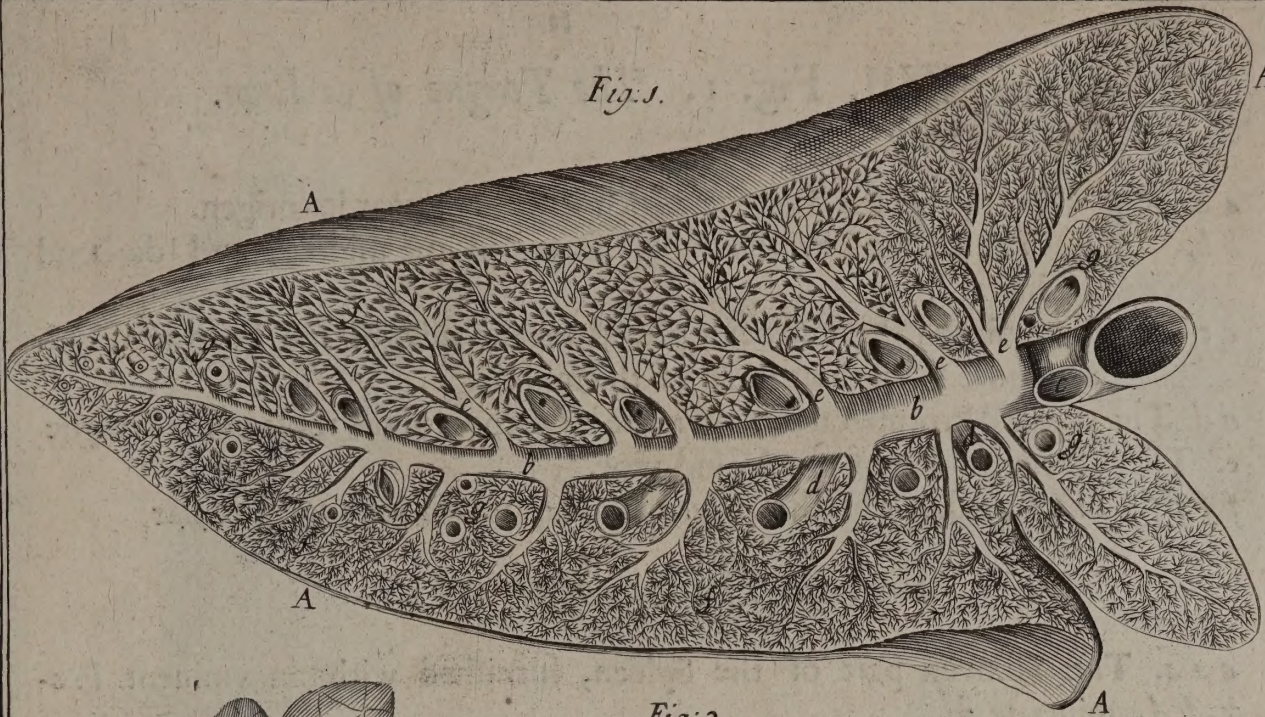


Fig. 2.

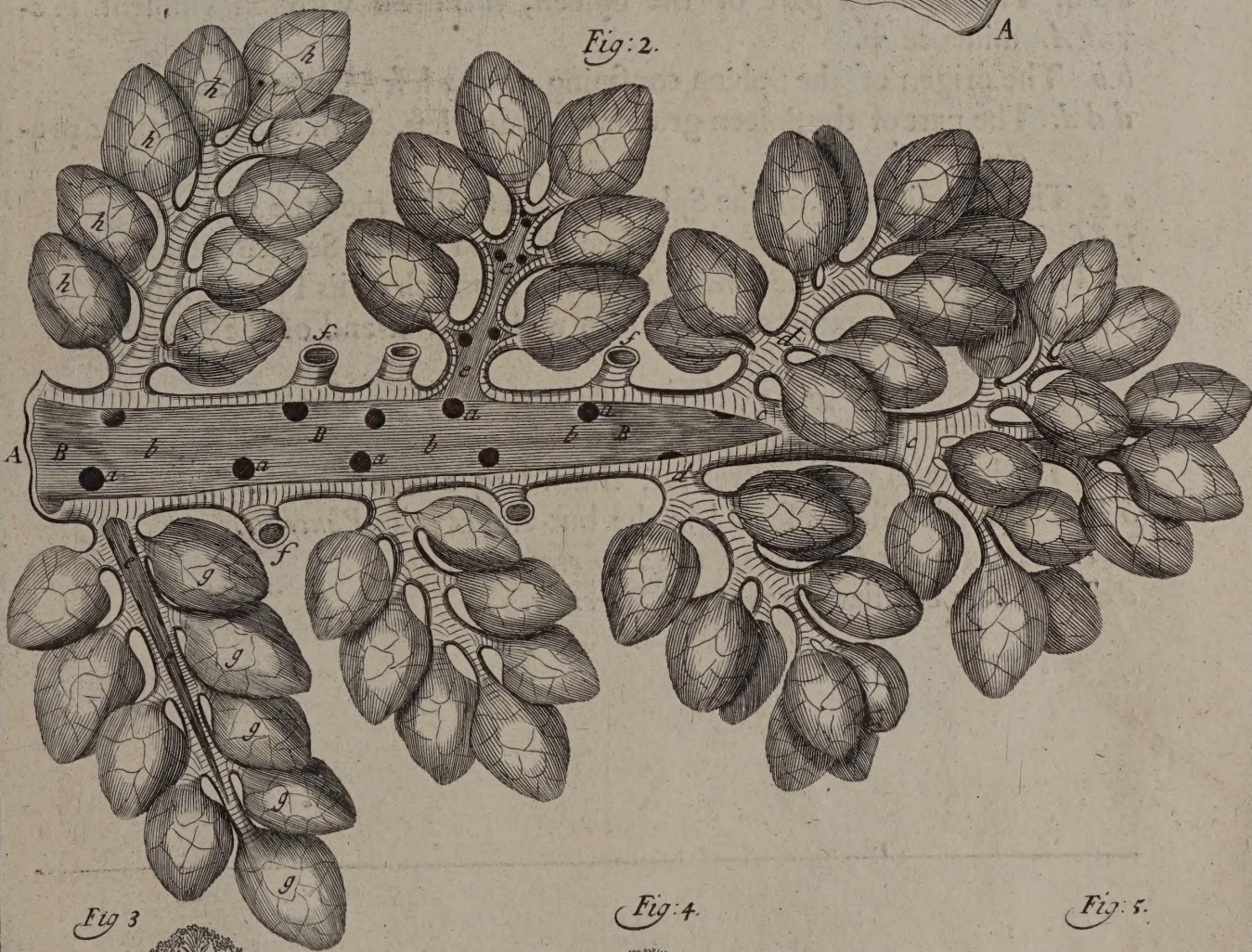


Fig. 3.



Fig. 4.

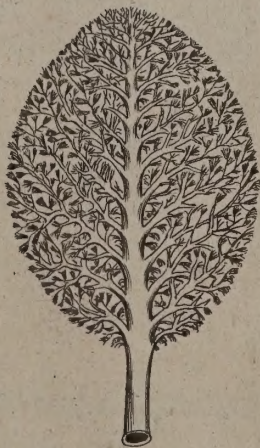


Fig. 5.



Tab. XVII. Fig. 1. *The Tongue of a Lion.*

- a a.* **T**He tip of the Tongue which is smooth near its origen.
b b. The pointed Protuberances seated in the middle, and do bend inward.
c c c c. The pointed Prominencies placed on the sides of the Tongue which are more small then those of the middle.
d d. The pointed Protuberancies are more large toward the roots of the Tongue.
e. The *Larynx* or top of the Wind-pipe.
f f f f. The Cartilages of the *Aspera Arteria*, which is almost circular.

Fig. 2. *The Spleen of a Lion.*

- a a a.* The Convex part of the Spleen, furnished with an eminent Pro-
+ *A A.* minence +.
b b. The origen of the Spleen confining on the left Hypoconder.
d d d. The part of the Spleen growing less and less, hath a more straight pro-
gress.
e e. The Termination of the Spleen, much smaller then the Origen.
f f f. The Concave part of the Spleen adorned with a Semicircular figure.
g. The connexion of the Spleen with the Stomach in its Protuberance.
b b. And the connexion of the Spleen with the but-end of the *Pancreas*.

Fig. 3. *The Pancreas of a Lion.*

- a a.* The but-end of the *Pancreas*, much larger then the rest.
b b. The small Glands seated in the but-end of the *Pancreas*.
c c c. The greater Glands of the *Pancreas*.
d d d d. The circular part of the *Pancreas*.

Fig. 1.

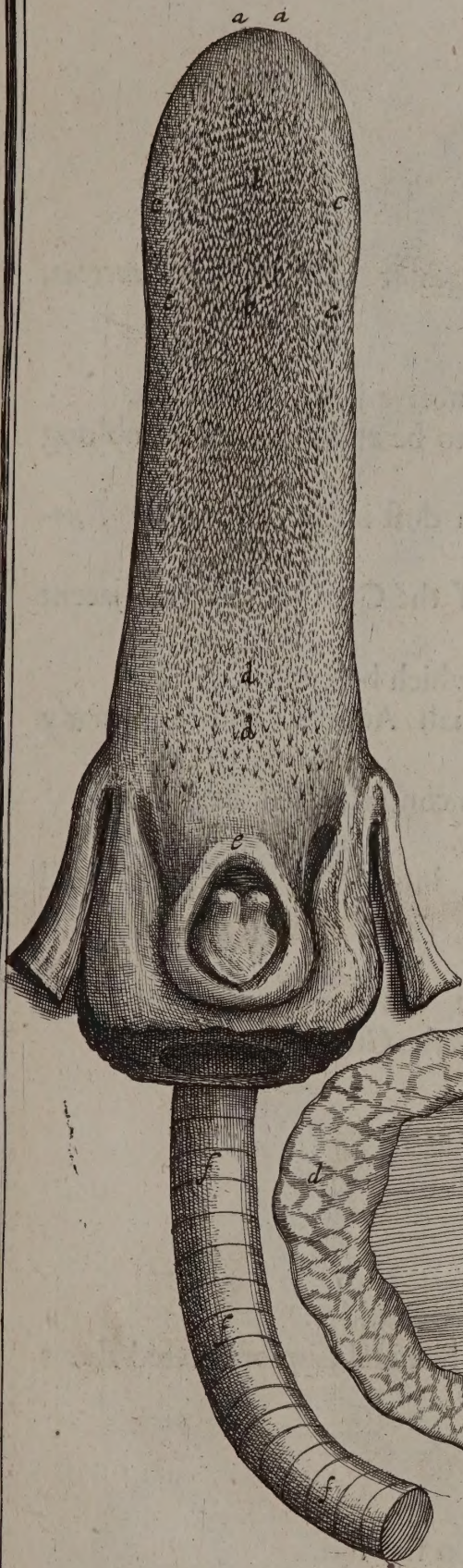
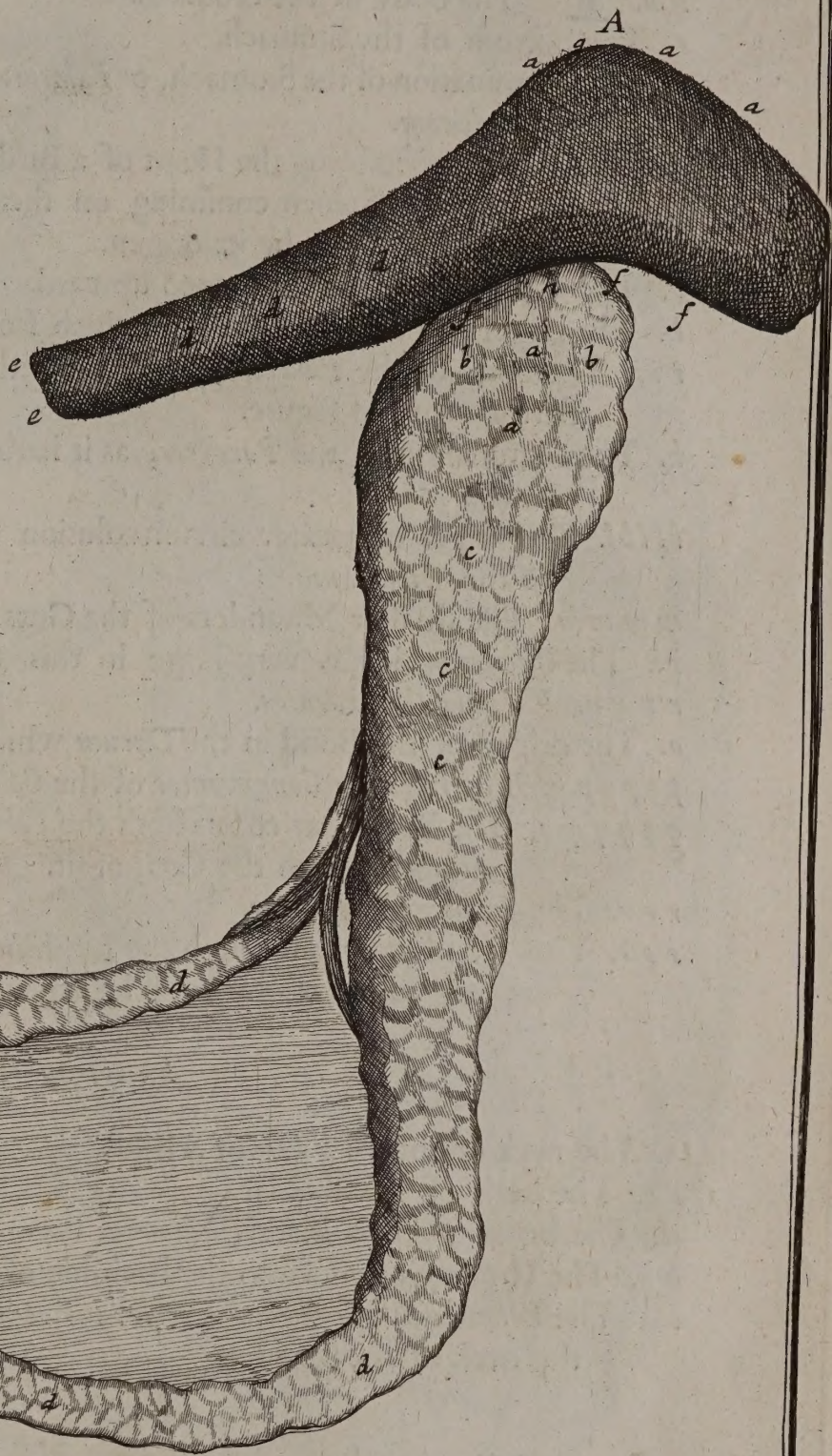


Fig. 2.



Tab. XVIII. Fig. 1. *The Viscera of an Ape.*

- a.* **T**he origen of the Stomach.
b b. The body of the Stomach.
c. The bottom of the Stomach.
d. The termination of the Stomach, or *Pylorus*.
e e. The *Duodenum*.
E. The Spleen resembling the Heart of a Bird.
f. The Base of the Spleen confining on the greater part of the *Pancreas*, which I conceive to be its origen.
g. The Cone of the Spleen turned upward.
h. The larger part of the *Pancreas*, which I conceive is its origination.
i i i. The body of the *Pancreas*, which seemeth to be endued with an oblong flattish crooked Figure.
k. The termination of the *Pancreas*, as it hath a duct inserted into the *Duodenum*.
l l l l. The larger or greater circumvolution of the Guts, which is adjacent to the *Duodenum*.
m m m m. The smaller Mæanders of the Guts which belong to the *Ilia*.
N. The *Cæcum* which is very large in this small Animal, and hath many
n n n n. *Valvula Conniventes*.
o. The origen of the Bond in the *Cæcum* which contracteth it into Cells.
p p p p p p. The *Valvula Conniventes* of the *Colon*.
q q q q q q. The Bond that contracteth the *Colon* into Cells, and passeth all along through the Coat of it.
r r r. The *Intestinum Rectum*.
s s s. The Bond passing through the *Intestinum*, doth contract it into Cells, as not being of the same length with the Gut.

Fig. 2.

- a.* The neck of the Bladder of Urine.
c c. The body of the Bladder.
d. The bottom of the Bladder.
b b. The Ureters inserted into the backside of the Bladder.
e e. The *Vesiculae Seminales* (the repositories of Seminal Liquor) seated about the neck of the Bladder.

Fig. 3.

- a a.* The Root of the *Penis* which is larger then the rest.
b b. The body of the *Penis*.
c. The Glans of the *Penis*.

Fig. 1.

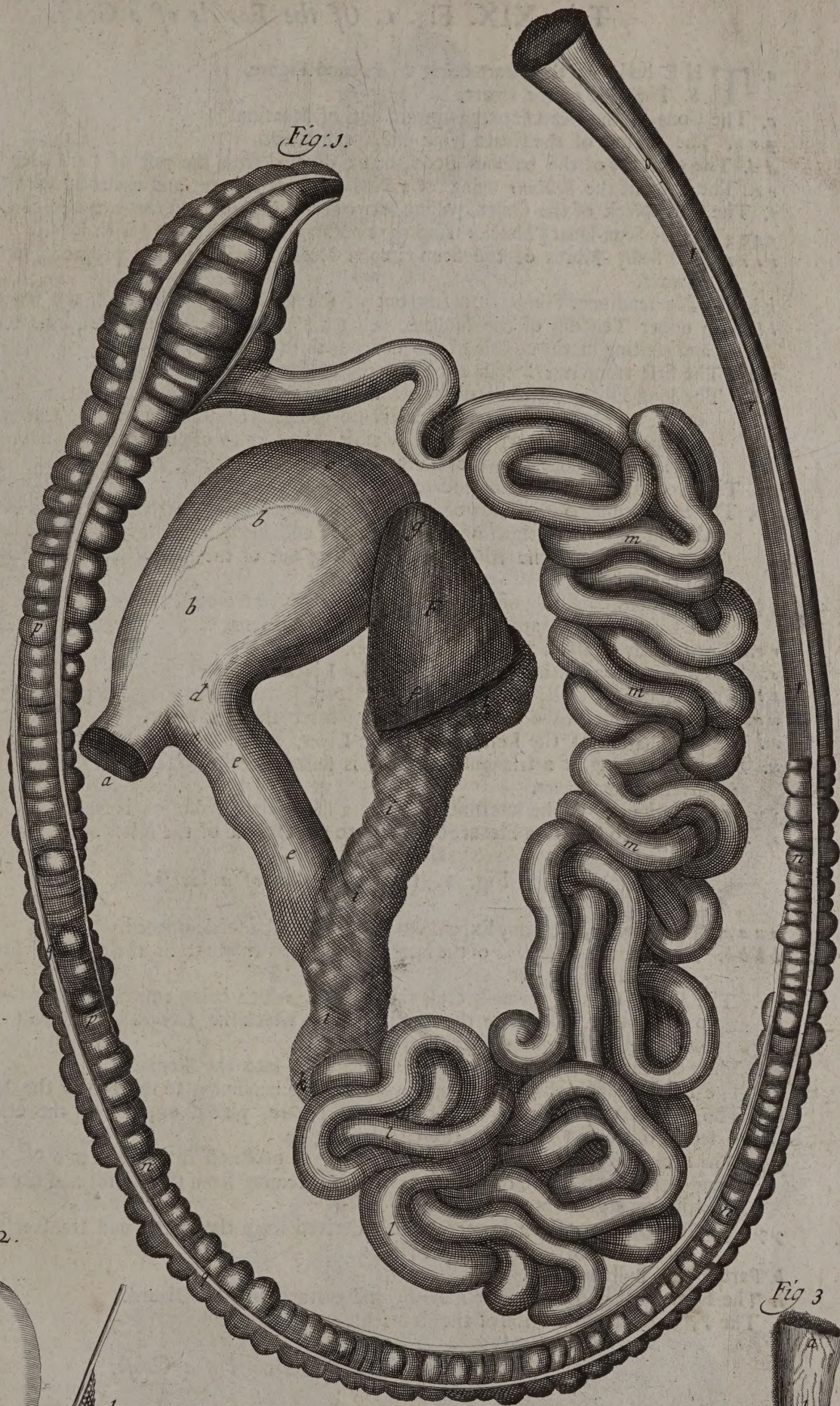


Fig. 2.

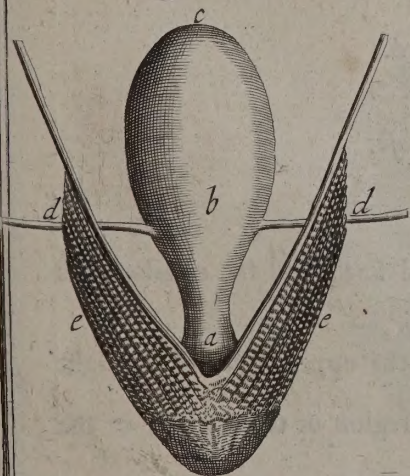


Fig. 3



Tab. XIX. Fig. 1. Of the Bowels of a Goose.

- a.** THE body of the Heart being of a round Figure,
b. The Base of the Heart.
c. The Cone of the Heart looking upward out, of situation.
β x x. The Auricle of the Heart lying under the Heart.
d d. The entrance of the bulbous Body, being divided from the rest of the Gullet.
e e. The body of the *Echinus* being of a kind of Oval Figure, and encircled with Oval Glands.
f. The short Neck of the Gullet, passing between the *Echinus*, and the entrance of the Gizard.
g g g g g. The Semi-lunary Muscles fringing the Margents of the Gizard with Red.
i i i i. The fleshy Fibres of the Semi-circular Muscles, making their progress in Flexures long-ways.
k k k k. The tendinous Fibres sprouting out of the Semi-lunary Muscles in the manner of Rays.
l l. The upper Tendons of the Muscles, being a union of tendinous Fibres, intersecting each other, and uniting in the middle of the Gizard, as in a Center.
m m. The first transverse Muscle affixed to the entrance of the Stomach.
n n. The long Fibres of this transverse Muscle, running from one extremity of the Muscle to the other, and being contracted gently, do protrude the Aliment into the Cavity of the Gizard, and being strongly contracted, do close the entrance of the Stomach, intercepting the passage of the Corn into the Gullet, in time of its grinding.
o o. The Second transverse Muscle seated opposite to the other.
p p. The long Semicircular Fibres of this Muscle, which being gently moved, do force the ground Aliment into the Origen of the Intestines; and being more briskly contracted, shut up the *Pylorus*, and keep the Aliment from passing out of the Stomach, till it is perfectly ground and concocted.
q q. The Tendons consisting of united Fibres, propagated from the transverse Muscles, do creep under the first Tendons, and intersect them in oblique lines.
r r. The Concave part of the Liver turned up.
s. The termination of the Right Lobe of the Liver.
t t. The Bladder of Gall, is of a Greenish colour, seated in the Concave part of the Liver.
u u. The Left Lobe of the Liver being much shorter then the other.
w. The termination of the Left Lobe of the Liver.
x. The Spleen being of a triangular Figure, is fastned to the Gizard and Guts, by the mediation of diverse Membranes.
y y. The beginning of the Intestines, wherein a short circumvolution is made.
z. The *Pancreas* lodged in a Flexure belonging to the Origen of the Intestines.

Fig. 2. Of the Gizard of a Goose.

- a a a a.** The *Lamina*, or fleshy Expansions of the lateral Muscle opened.
b b b b. The numerous *Lamina* of the lateral Muscle, as they are in their natural situation, without any division by Art.
c c. The Fibres running variously cross the *Lamina*, which being contracted, put the *Lamina* closer to each other, and move the Cartilages (to which the *Lamina* are fastned by tendinous Fibres) up and down in several Positions.
d d. The first transverse Muscle encircling the entrance into the Stomach.
e e. The Fibres passing obliquely long-ways, from the beginning to the end of the Muscle.
f f. The Second transverse Muscle of an Oval Figure, placed opposite to the other, and is beset with many Fibres of a Semi-circular Figure.
g g. The lower Tendon (appearing as the other) is taken off in the form of a *St. Andrews Cross*, and is made up of fruitful tendinous Fibres (coming from the lateral and transverse Muscles) uniting in a great broad common Tendon.
z z z z. The Origen of the lower Tendon, derived from the lateral and transverse Muscles, having Semi-circular tendinous Fibres.
b. Part of the Bulbous Body.
i. The Neck passing between the *Echinus*, and entrance into the Gizard.
k. The *Pylorus*, or termination of the Stomach.

Fig. 3. Belonging to the Gizard of a Goose.

- a a a a.** The Cartilaginous Plates of a kind of circular Figure.
b b. The Fissures of the Scute or cartilaginous Plates.
c c. The tendinous Fibres of the lateral Muscles fastned to the outward surface of the cartilaginous enclosures, seated in the inside of the Gizard.
d d d. The Cavities of the *Scuta*, of Cartilaginous Plates.
e e e e. The Semi-circular ridge, or prominence of the Scutum seated in the upper region of the right side of the Gizard.
f f f f. The Semi-circular ridges of the *Scutum*, placed in the lower region of the left side of the Gizard.
g g g g. The Cavities of the Cartilaginous Plates.

Fig. 1.

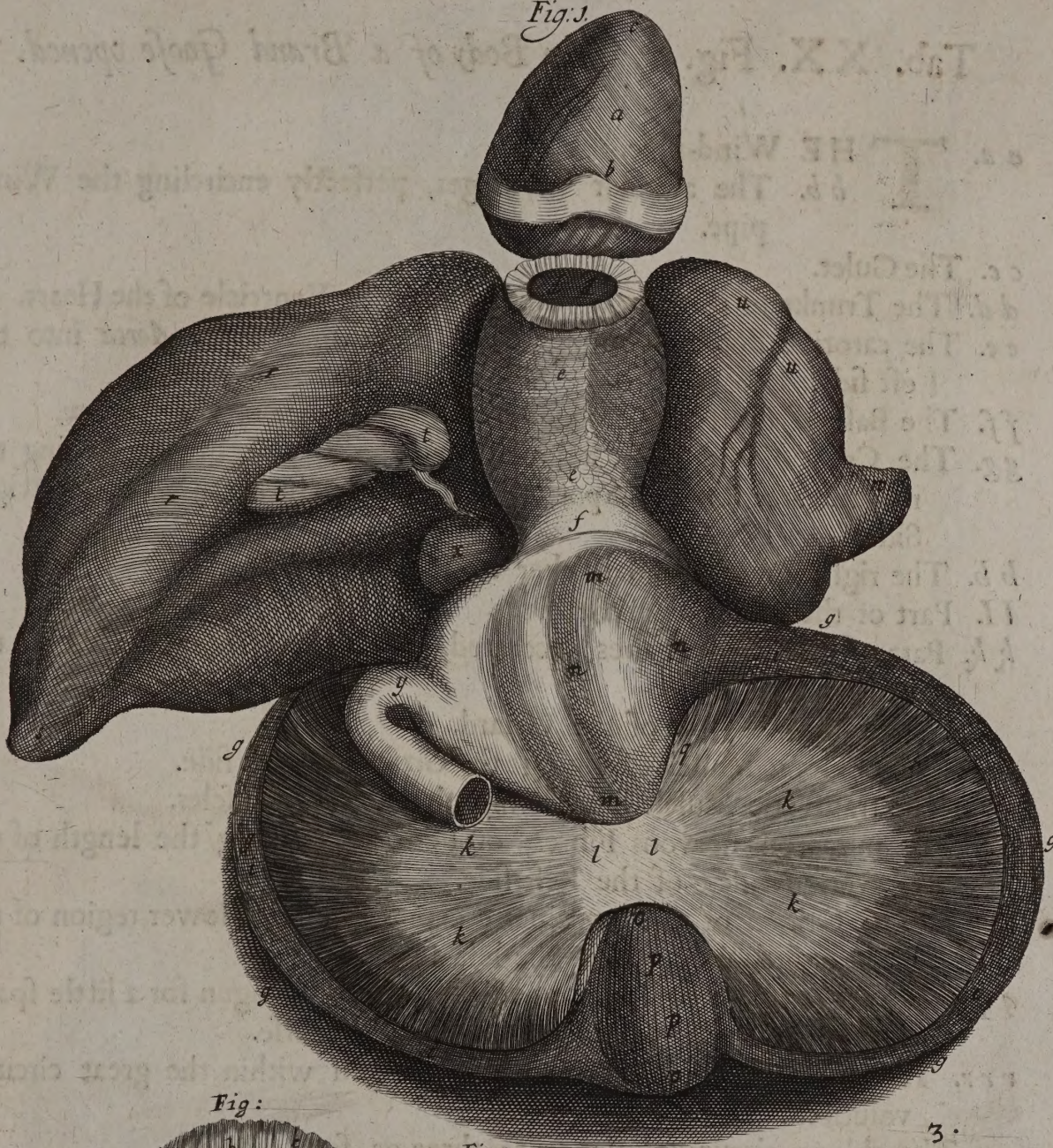


Fig.

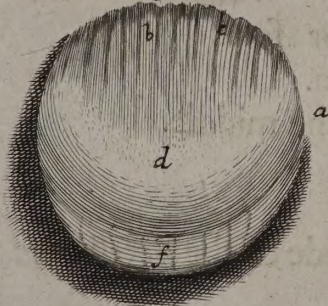
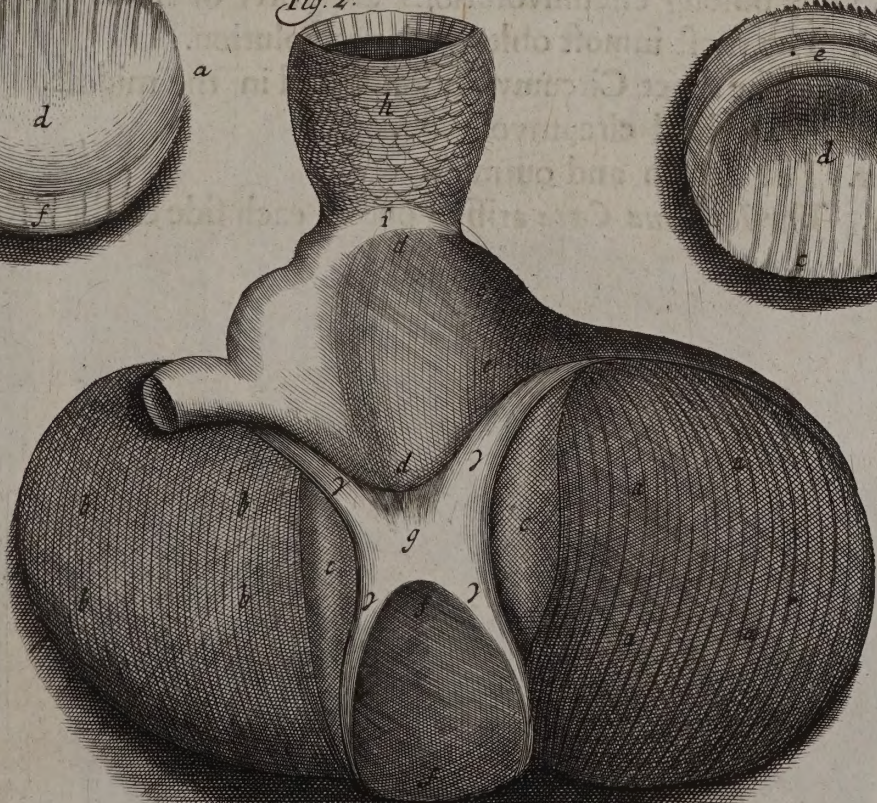
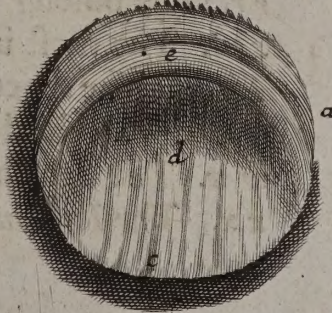


Fig. 2.



3.

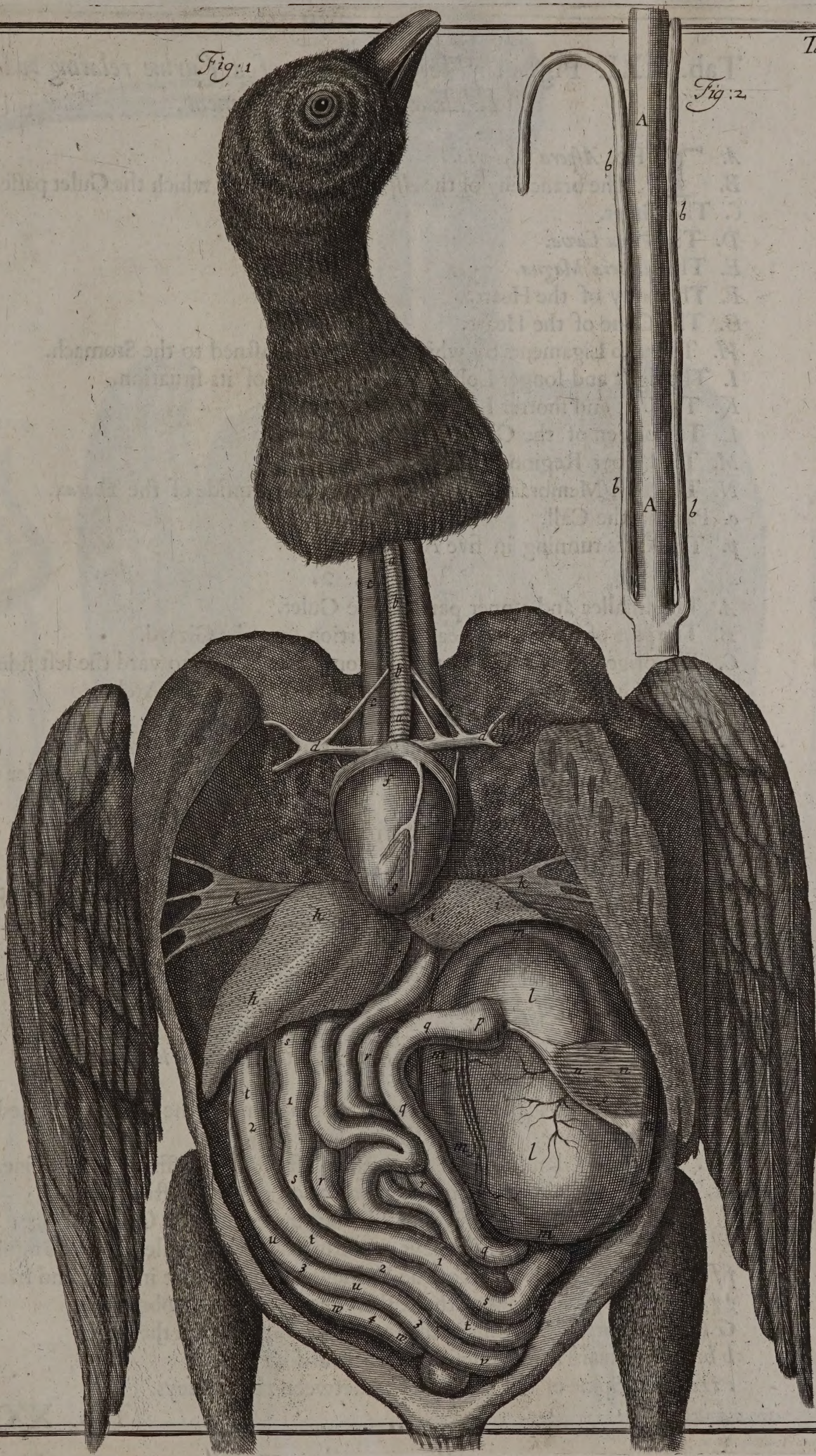


Tab. XX. Fig. 1. *The Body of a Brand Goose opened.*

- a a.* **T**HE Wind-pipe.
b b. The annular Cartilages, perfectly encircling the Wind-pipe.
c c. The Gullet.
d d. The Trunks of the *Aorta*, arising out of the Ventricle of the Heart.
e e. The carotide Branches arising out of the Trunk of the *Aorta* into the Left side.
f f. The Base of the Heart, lodged near the entrance of the *Thorax*.
g g. The Cone of the Heart adjoyning to the Intersepiment, parting the middle and lower Apartments, and inclineth toward the Right Side.
h h. The right, broader and thicker Lobe of the Liver.
II. Part of the left Lobe of the Liver.
k k. Part of the Membranes lacerated, and turned to each side of the *Thorax*.
ll. The lower region of the Gizard.
m m. The oblong Muscles fringing the Gizard on each side.
n n. The transverse Muscle intersecting the oblong Muscles.
o o. The numerous nervous Fibres, or Tendons, passing the length of the transverse Muscle of the Left side.
† p p. The Origen of the Intestines creeping out of the lower region of the Gizard† inclining toward the left side.
q q q. The first Gut wheeling immediately after its Origen for a little space, and then goeth in a kind of a straight course.
r r r. The short Gyres of the Intestines lodged within the great circumvolutions.
r r. The oblong circumvolutions are three or four.
s s s. The most inmost oblong circumvolution.
TTT. The next Circumvolution seated in the middle.
u u u. The third circumvolution.
w w. The fourth and outmost.
x x. The *Intestina Cæca* arising out of each side of the *Intestinum notum*.

Fig: 1

Fig: 2



Tab. XXI. Fig. 1. *The first Figure of a Curlue relating to the Middle and lower Apartment.*

- A. **T**he *Aspera Arteria*.
- B. The branching of the *Aspera Arteria*, under which the Gullet passeth.
- C. The Gullet.
- D. The *Vena Cava*.
- E. The *Arteria Magna*.
- F. The body of the Heart.
- G. The Cone of the Heart.
- H. The two Ligaments by which the Heart is fastned to the Stomach.
- I. The right and longer Lobe of the Liver out of its situation.
- K. The left and shorter Lobe of the Liver.
- L. The origen of the Gizard or Stomach.
- M. The upper Region of the Stomach.
- N. The thin Membrane investing the Heart and inside of the *Thorax*.
- o. Part of the Call.
- p. The Guts running in five Arches.

Fig. 2.

- A. The smaller and upper part of the Gullet.
- B. The part of the Gullet near its insertion into the Gizard.
- C. The origen of the first Gut arising on the beginning toward the left side of the Gizard, passing over the Gullet in the form of an Arch.
- D. The body of the Gizard.
- E. The Protuberance seated near the termination of the Gizard.
- F. The first Intestine where it appeareth again after it hath passeth under the Gizard.

Fig. 3.

- G. The *Colon*.
- H. The *Intestinulum Cæcum*, arising out of the left side of the *Colon* about its termination, or rather the beginning of the *Intestinum Rectum*.
- I. The *Intestinulum Cæcum* ascending on the right side.
- K. The beginning of the *Intestinum Rectum*, where it is smaller.
- L. The broader part or termination of the *Intestinum Rectum*.

Fig. 4. *The Kidneys and Testicles of a Turkey, &c.*

- a a. The Testicles seated between the originations of the Kidneys fastned to the Spine, of which the left is the largest.
- b b. The renal Glands placed above the Testicles, and affixed to the Spine.
- c c. The Glands adjoyning to the termination of the Testicles.
- d. The right origen of the Kidneys being single and of a Conick figure.
- e. The left origen of the Kidneys consisting of two Lobules of divers figures.
- ffff. The middle Lobules of the Kidneys being different in shape and size.
- gggg. The terminations of the Kidneys made of two Lobules.
- G G. The outward is Semicircular and much longer then the other.
- h h. The inward is much less and of a Pear-like figure.
- i i i i. The Spine of the Back passing between the Kidneys.

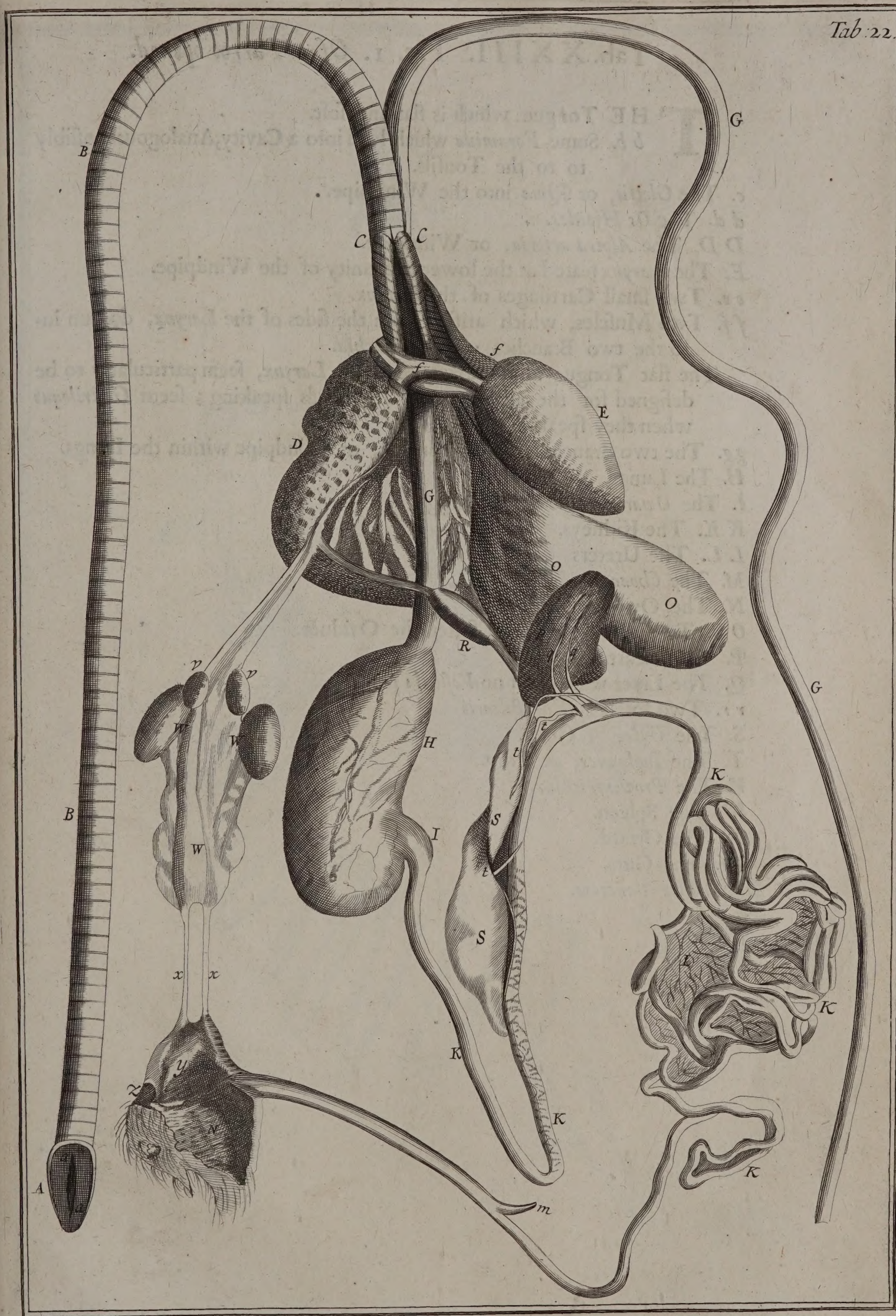
Tab. XXII.



Tab. XXII. Fig. 1. *The Body of a Heron opened by
Dr. Edward Tyson.*

- A. **T**He *Larynx*, or top of the Wind-pipe, which had no *Epiglottis*,
† a a. but a large *Glottis* or *Rima* encompassed with two large Muscles †.
- B B. The *Aspera Arteria*, or Wind-pipe was long, consisting of an abundance
of annular Cartilages seated above the Branches.
- C C. The Cartilages are almost Semicircular, where the Wind-pipe was di-
vided, first into two Branches, and afterward into many.
- D. The Lungs, which were full of holes both in the outward Surface, and
more inwardly.
- E. The Heart of this Fowl is very long and large.
- ff. The great Artery arising out of the Heart.
- GGG. The Gullet, which is inserted into the origen of the Stomach.
- H. The Stomach being curiously enameled with Blood-vessels, is outwardly
Membranous and lined inwardly with a white hard Pellicle, resem-
bling that of a Gizzard of other Fowls; the Stomach of this Fowl being
opened, was found to be crammed with Water *Scarabæi*, or Beetles,
and it was curious to observe toward the upper Orifice between the
Coats, that many small Glands were beset with Excretory Vessels,
spuing out a white Juice, as a Ferment (to open the body of the Ali-
ment lodged in the Stomach) which is the better imparted by the
strong Muscles of the Gizzard squeezing out a fermentative Juice into
its Cavity.
- J. The *Pylorus* or termination of the Stomach.
- K K K. The Intestines are long and of one bigness, and full of many
Mæanders.
- L. The Mesentery.
- M. The *Intestinum Cæcum*, which is single and small in this Fowl, and dou-
ble in most others.
- N. The *Cloaca* is a large bag filled with a whitish clammy mucous Matter
which may be conceived to be muted on the Wings of a Hawk
(by a Heron soaring above her) to hinder her pursuit.
- O O. The Liver divided into two Lobes.
- P. The Bladder or Gall.
- q q. Two *Ductus Biliarii*.
- R. The Spleen (as I conceive) is of a very florid Red Colour.
- S S. The *Pancreas* is very large.
- t t t. This Bowel hath three fair Excretory Ducts, of which two were
seated in the Intestine near the *Ductus Biliarii*, and the third more re-
mote from thence.
- U U. The Testicles.
- W W W. The Kidneys are large in this Fowl.
- XX. The Ureters.
- Y. A Bladder or Bag, containing a transparent Liquor, which I conceive to
† Z. be Urine emptied by an Orifice † into the *Cloaca*. N. as above.

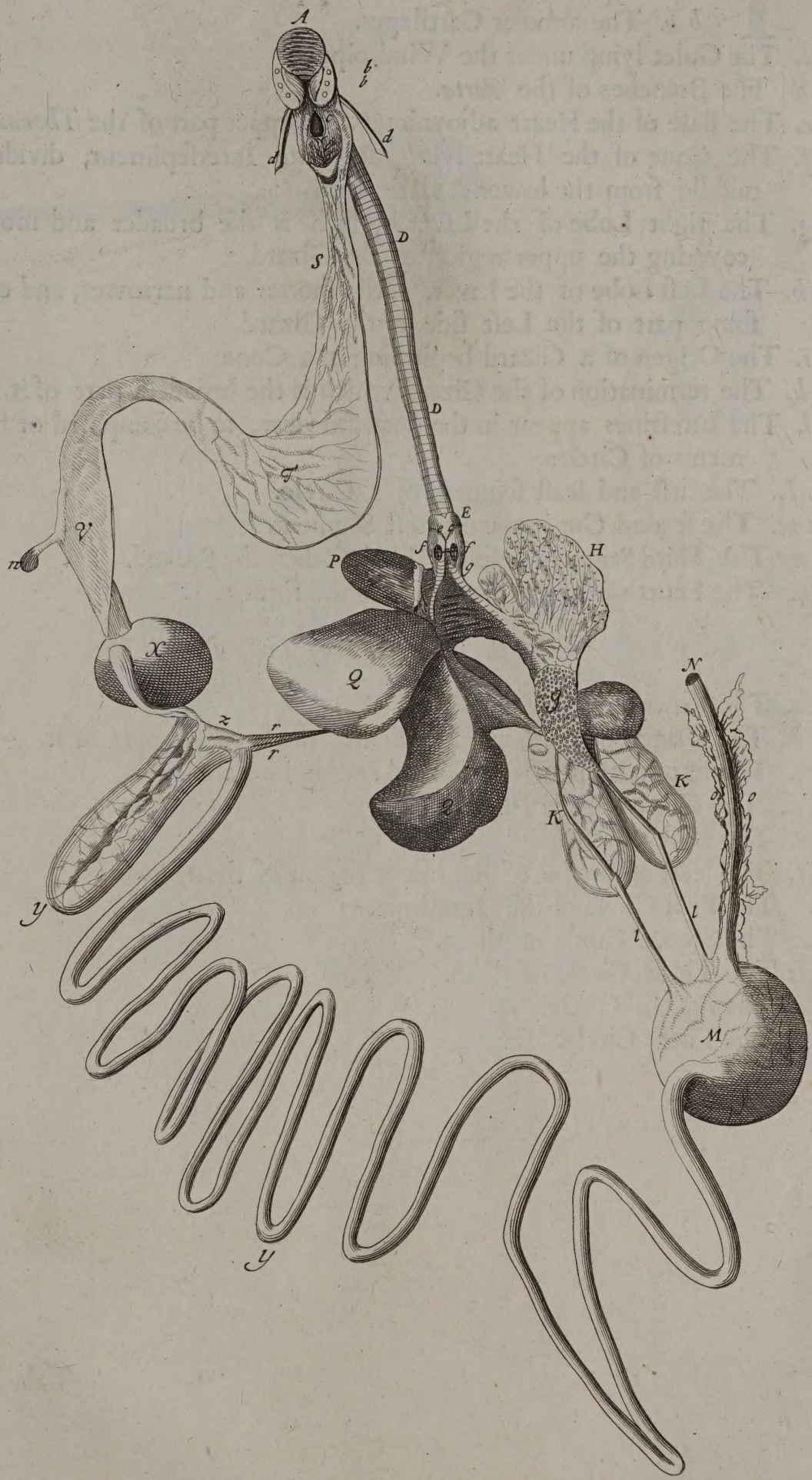
Tab. XXIII



Tab. XXIII. Fig. 1. Of a Parrot opened.

- a.** **T**HE Tongue which is flat and soft.
b b. Some *Foramina* which lead into a Cavity, Analogous possibly to to the Tonfils.
c. The *Glottis*, or *Rima* into the Windpipe.
d d. The *Os Hyoides*.
D D. The *Aspera arteria*, or Windpipe.
E. The *Larynx* seated at the lower extremity of the Windpipe.
e e. Two small Cartilages of the *Larynx*.
ff. Two Muscles, which arising from the sides of the *Larynx*, do run into the two Branches of the *Bronchia*.
 The flat Tongue and contrivance of the *Larynx*, seem particularly to be designed for the advantage of the Birds speaking; seem *Gastriloqui* when they speak.
gg. The two Branches of the *Bronchia*, or Windpipe within the Lungs.
H. The Lungs.
I. The *Ovarium* full of small Eggs.
K K. The Kidneys.
L L. The Ureters.
M. The *Choaca*.
N. The Oviduct.
O O. Two Membranes that fasten the Oviduct.
P. The Heart.
Q. The Liver which had no *Vesicula felleis*.
r r. Two small *Ductus Biliarii*
S. The *Gula*, or Gullet.
T. The *Ingluvies*, or Crop.
V. The *Proventriculus*.
W. The Spleen.
X. The Gizzard.
YY. The Guts.
Z. The *Pancreas*.

Tab. XXIV.



Tab. XXIV. Fig. 1. *The Body of a Snipe opened.*

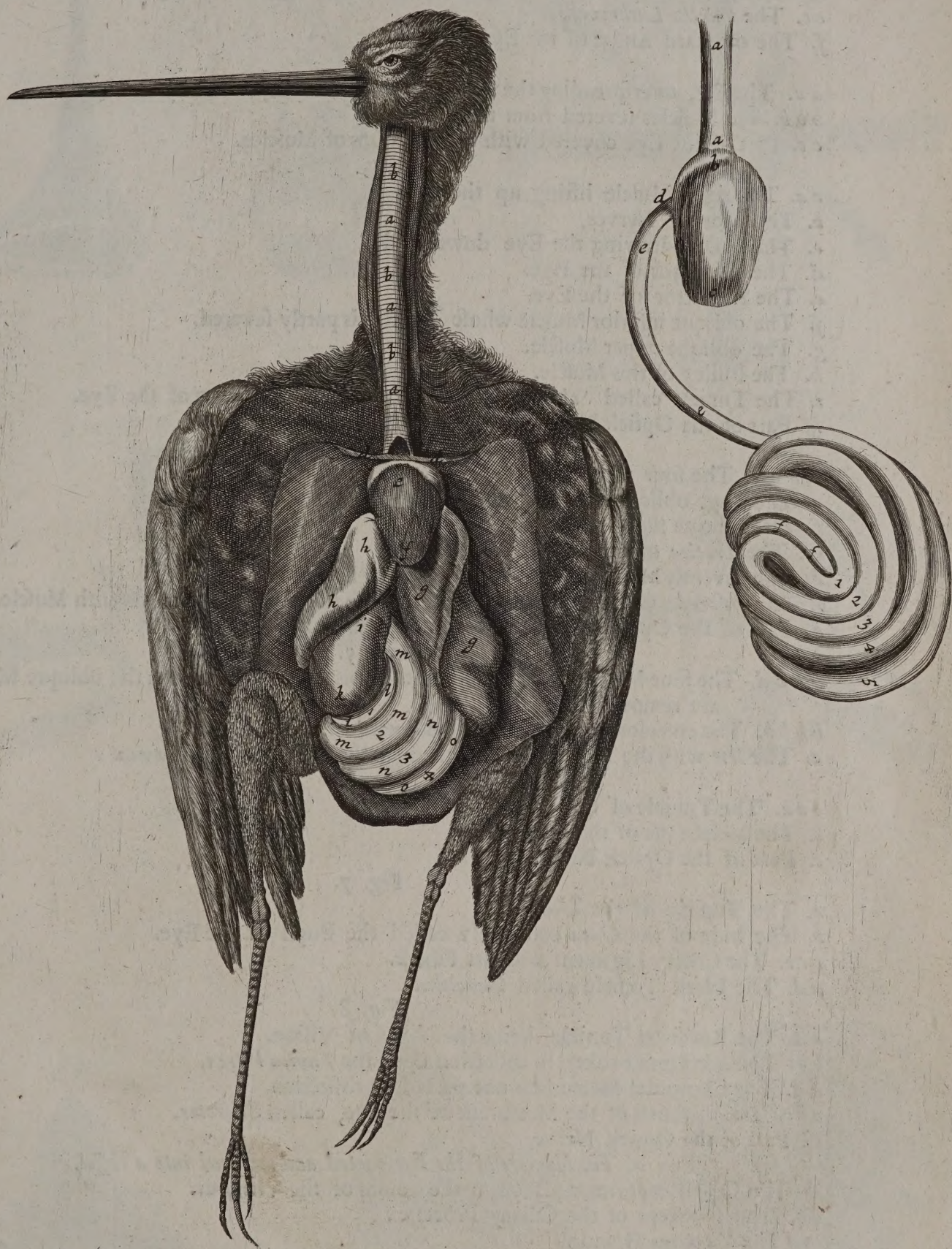
- a.* **T**HE *Aspera Arteria*, or Wind-pipe.
b b. The annular Cartilages.
c c. The Gullet lying under the Wind-pipe.
d d. The Branches of the *Aorta*.
e e. The Base of the Heart adjoyning to the upper part of the *Thorax*.
f f. The Cone of the Heart lying near the Intersepiment, dividing the middle from the lower Apartiment.
g g. The right Lobe of the Liver, which is the broader and more long covering the upper region of the Gizard.
h h. The Left Lobe of the Liver, is the shorter and narrower, and covereth some part of the Left side of the Gizard.
i i. The Origen of a Gizard beginning in a Cone.
k k. The termination of the Gizard which is the broadest part of it.
l l. The Intestines appear in the outward view, to be composed of four segments of Circles.
L L. The first and least segment of a Circle.
m m. The second Gut is the greatest Segment.
n n. The Third Segment is somewhat less then the Second.
o o. The Fourth is more minute then the former.

Fig. 2. *The Bowels of a Woodcock.*

- a a.* The Bowels of a Woodcock.
b b. The Origen of the Gizard, which is the broadest part of it.
c c. The termination of the Gizard ending into a Cone.
d d. The Origen of the Intestines.
e e. The First Intestine.
f f. The least *Anfractus* of the lower region of the Guts.
g. The First Circle of the Intestines.
h. The Second Circle of them.
i. The Third Circle of them.
k. The Fourth Circle.
l. The Fifth Circle.

Fig. 1.

Fig. 2.



Tab. XXV. Fig. 1. *An Explanation of the parts of the Eye.*

- a a.* **T**he Levator of the upper Eye-brow.
b. The Expansion of the Tendon.
c c. The Hairs of the Eye-lids.
D. The *Caruncula Lachrymalis* seated in the inward Angle of the Eye.
e e. The *Puncta Lachrymalia*.
f. The outward Angle of the Eye-brow.

Fig. 2.

- a a.* The Fat, overspreading the hinder region of the Eye.
b b b. The Muscles severed from the Eye.
c c. Part of the Eye covered with the Tendons of Muscles.

Fig. 3.

- a a.* The right Muscle lifting up the Eye.
b. The Motory Nerves.
c. The Muscle drawing the Eye downward.
d. The Adductor of the Eye.
e. The Abductor of the Eye.
f. The oblique inferior Muscle whose Tendon is partly severed.
g. The oblique upper Muscle.
h. The Pulley of this Muscle.
i. The Tunicle called *Sclerotes* encompassing the hinder region of the Eye.
k. Part of the Optick Nerve inserted into the Eye.

Fig. 4. *Explaining the Eye of a Sheep.*

- A b c d.* The four right Muscles.
e. The large oblique inferior Muscle being small.
f. The oblique superior Muscle.
G. The *Troclea* of this Muscle.
h. The seventh Muscle relating to the Eye of Bruities.
i. The posterior region of the Eye covered with the Tendon of the seventh Muscle.
k. Part of the Optick Nerve inserted into the seventh Muscle.

Fig. 5.

- A b c d.* The four Muscles (expressed in the former Figures) when the oblique Muscles are removed.
b b b b. The common Membrane, called *innominata*.
a. The *Iris* with the *Pupil* appearing through the Tunicle of the *Cornea*.

Fig. 6.

- a a a.* The Tunicle of the *Sclerotes* dissected.
b. The Membrane of the *Cornea*.
c. Part of the Optick Nerve.

Fig. 7.

- a.* The Tunicle of the *Uvea*.
b. The hole of the *Uvea* commonly called the Pupil of the Eye.
c c c. The Ciliary Ligament with its Fibrils.
d d. The black Tunicle called *Choroides*.

Fig. 8.

- a a.* The Retiform Tunicle, being the subject of Vision.
b b. The Retiform broken in dissection upon the *Tunica Vitrea*.
d d. The Choroidal Membrane not parted by dissection.
c c c. The thickness of the Membrane of the Eye, called *Sclerotes*.
E. Part of the Optick Nerve.

Fig. 9. *The Humors of the Eye parted and received into a Vessel.*

- A.* The Cristalline humor placed in the bosom of the Vitreous.
b b. The footsteps of the Ciliary Processes.
c c. The Vitreous Humor.
d d. The watry Humor encompassed by the Vitreous.

Fig: 1.

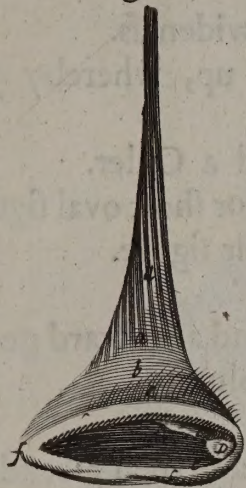


Fig: 2.

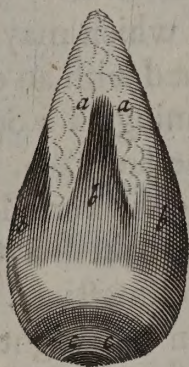


Fig: 3.

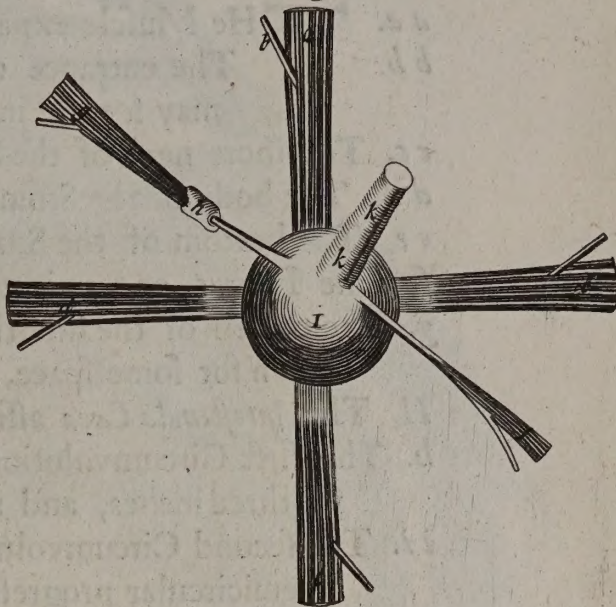


Fig: 4.

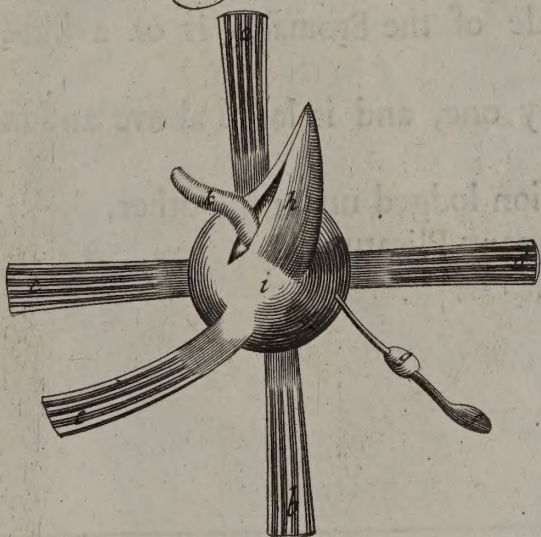


Fig: 5.

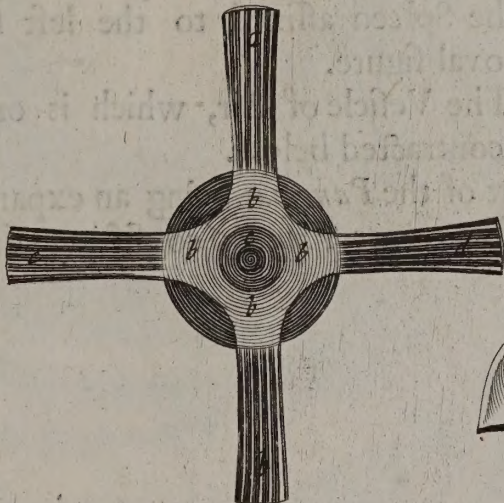


Fig: 6.

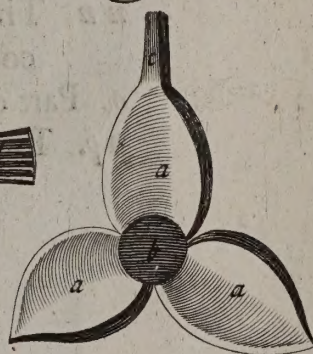


Fig: 7.

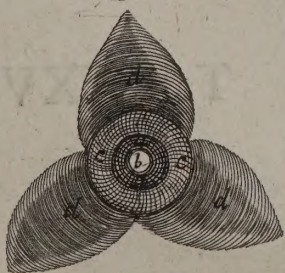
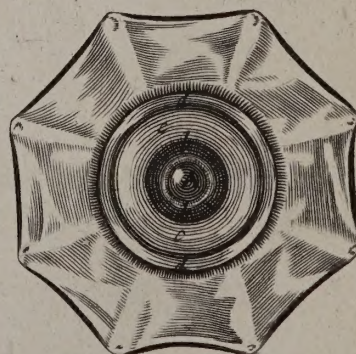


Fig: 8.



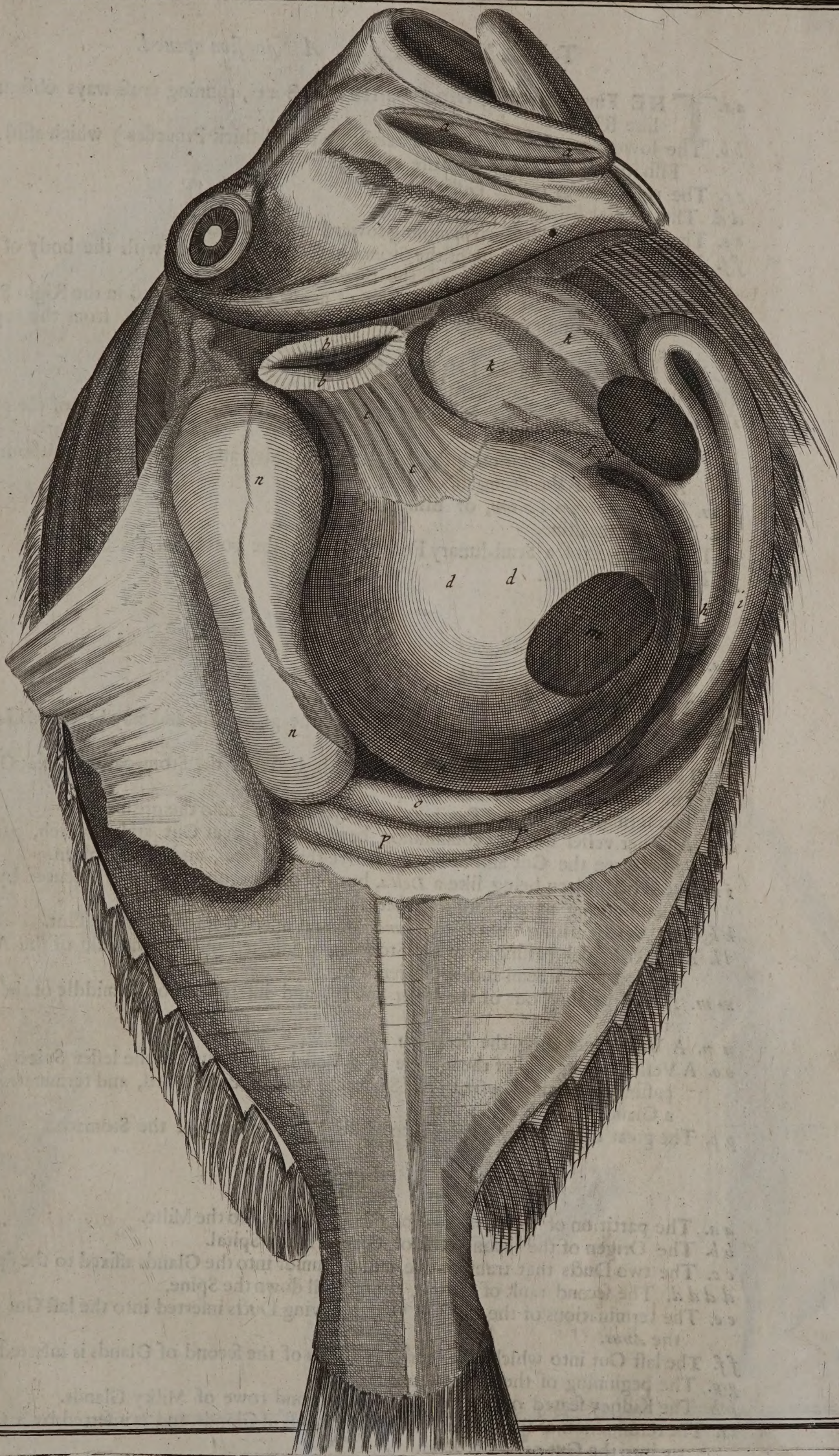
Fig: 9.



Tab. XXVI. Of a Dory opened.

- a a.* **T**He Muscle expanding the Mouth to a great wideness.
b b. The entrance of the Stomach being turned up, whereby you may see the inward Folds of it.
c c. The short neck of the Stomach, which may be styled a Gullet.
d d. The body of the Stomach adorned with an orbicular or short oval figure.
e e. The bottom of the Stomach running in a Semicircular figure.
f. The *Pylorus* or termination of the Stomach.
g. The origen of the Intestines, which is very slender, and afterward goeth down for some space, and then maketh a Circumvolution.
H. The *Intestinula Cæca* affixed to the Intestines.
h. The first Circumvolution goeth in a straight course, and then ascendeth for three inches, and maketh a second Circumvolution.
i i. The second Circumvolution, where the Intestines grow larger, maketh a Semicircular progress round the bottom of the Stomach.
k k. Part of the Liver seated in the left side.
l. The Bladder of Gall being of an oval figure, is seated in the left side.
m. The Spleen affixed to the left side of the Stomach, is of a kind of oval figure.
n n. The Vesicle of Air, which is only one, and is large above and more contracted below.
o. Part of the *Pancreas* being an expansion lodged under the other.
p p. The upper *Pancreas* consisting of many Plicatures.

Tab. XXVII.



Tab. XXVII. Fig. 1. *A Kingston opened.*

- a a.** THE Fins resembling Wings, parted with Bones, running cross-ways obliquely like Ribs.
- b b.** The lower Fins (to which are affixed two round thick Processes) which assist the Fish in swimming in the nature of Oars.
- c c.** The right Fibres of the Gullet.
- d d.** The circular Fibres of the Gullet.
- e e.** The body of the Stomach inclining toward the Left Side.
- f f.** The Process or Appendix of the Stomach (making an Arch with the body of the Stomach) ascendeth toward the Right Side.
- g g.** The soft Rowe, or Milte, consisting of many partitions seated in the Right Side.
- h h.** The Vessel running all along the middle of the Rowe, or Milte, from the top to the bottom.
- i i.** The Rowe seated in the Left Side, somewhat out of situation.
- k k.** The beginning of the Intestines.
- i i.** The termination of the *Pancreas*, appearing upon the upper surface of the great Gut.
- l l.** The Body of the Intestine lodged in the Left Side, and passeth down without the Appendix of the Stomach.
- m m.** The *Intestinum Cæcum*, or Blind Intestine.
- n n.** The last Intestine.
- o.** The Spleen is of a Semi-lunary Form, encircling the bottom of the Stomach,
- p.** The *Anus*, or Vent.

Fig. 2.

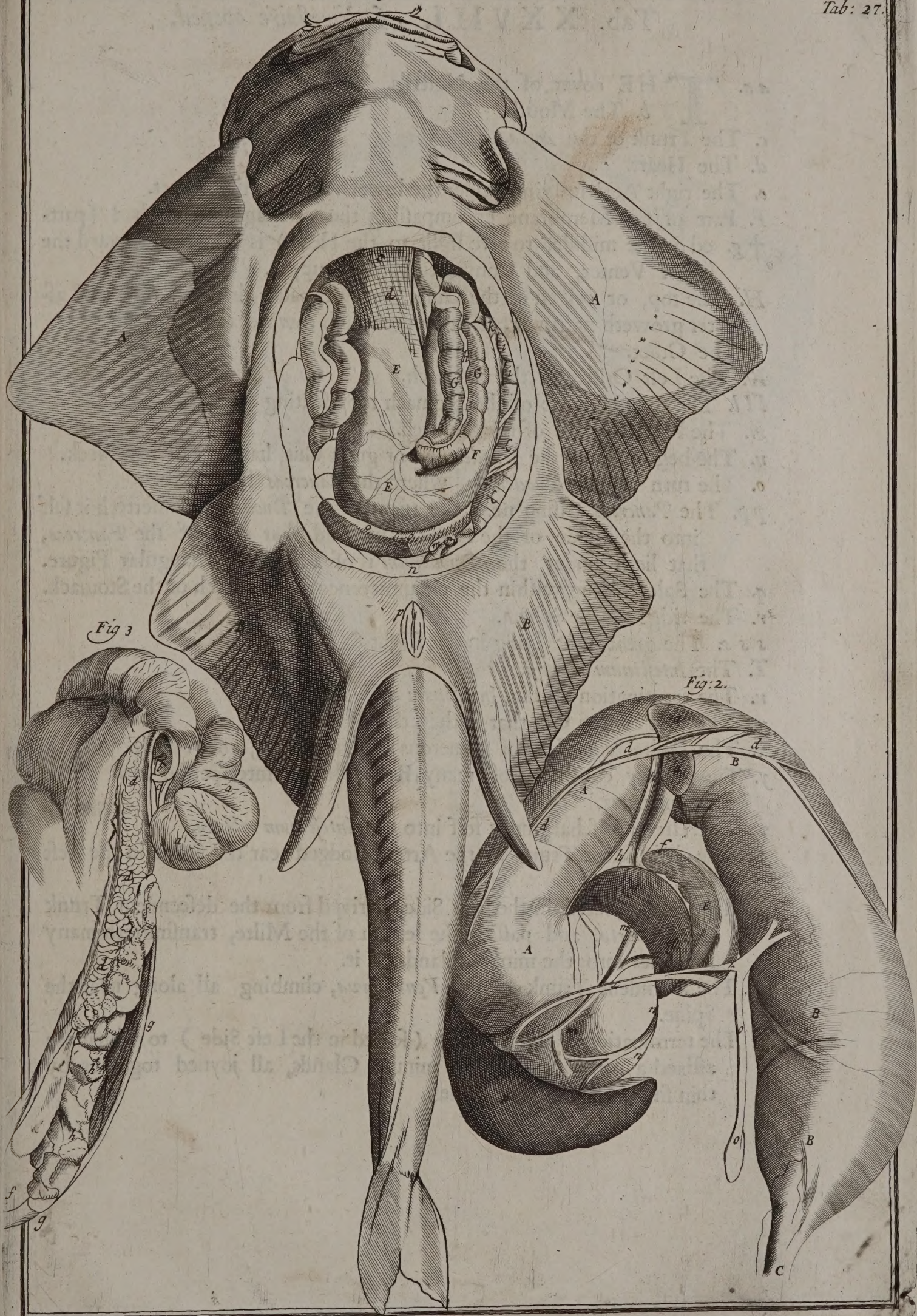
- a a.** The Stomach.
- b b.** The great Gut, or Intestine.
- c c.** The termination of the Gut.
- d d.** The Vessel passing from the Stomach into the great Gut, and may be called *Gastri-ca intestinalis*.
- e e.** The body of the *Pancreas* lying underneath, between the Stomach and great Gut.
- f f.** The Neck of the *Pancreas*
- g g.** The termination of the *Pancreas*, conveying a Duct into the great Gut.
- h h.** Another vessel holding communion between the great Gut and Stomach, passing between the Gut and Stomach, above the *Pancreas*, and lesser Spleen.
- i i.** The lesser Spleen being like a *Delta*, but out of its proper seat, and obscured by the neighbouring parts, doth resemble somewhat of a Semi-circle.
- k k.** The Vessel arising out of the *Pancreas*, and inserted into the great Gut.
- l l.** Another Vessel passing over the Stomach, is inserted into the middle of the Arch, relating to the Semi-lunary Spleen.
- m m.** A Vessel arising out of the lesser Spleen, and inserted into the middle of the Stomach.
- n n.** A Vessel encircling the Stomach.
- o o.** A Vessel arising out of the middle of a Vessel, going out of the lesser Spleen, and passing over the *Pancreas*, and Stomach, tendeth downward, and terminates into a Gland.
- p p.** The great Semi-lunary Spleen encompassing the bottom of the Stomach.

Fig. 3.

- a a.** The partition of the first rowe of Glands relating to the Milte.
- b b.** The Origin of the second rank of Glands being Spiral.
- c c.** The two Ducts that transmit the milky Humor into the Glands affixed to the Spine.
- d d d d.** The second rank of Glands, running all down the Spine.
- e e.** The terminations of the ranks of Glands having Ducts inserted into the last Gut near the *Anus*.
- f f.** The last Gut into which the excretory Ducts of the second of Glands is inserted.
- g g.** The beginning of the Kidney in a point.
- h h.** The Kidney seated on the outside of the second rowe of Milky Glands.
- i i.** The termination of the Kidney in a small Process of Glands, and is inserted by a Center into the Gut near the *Anus*.

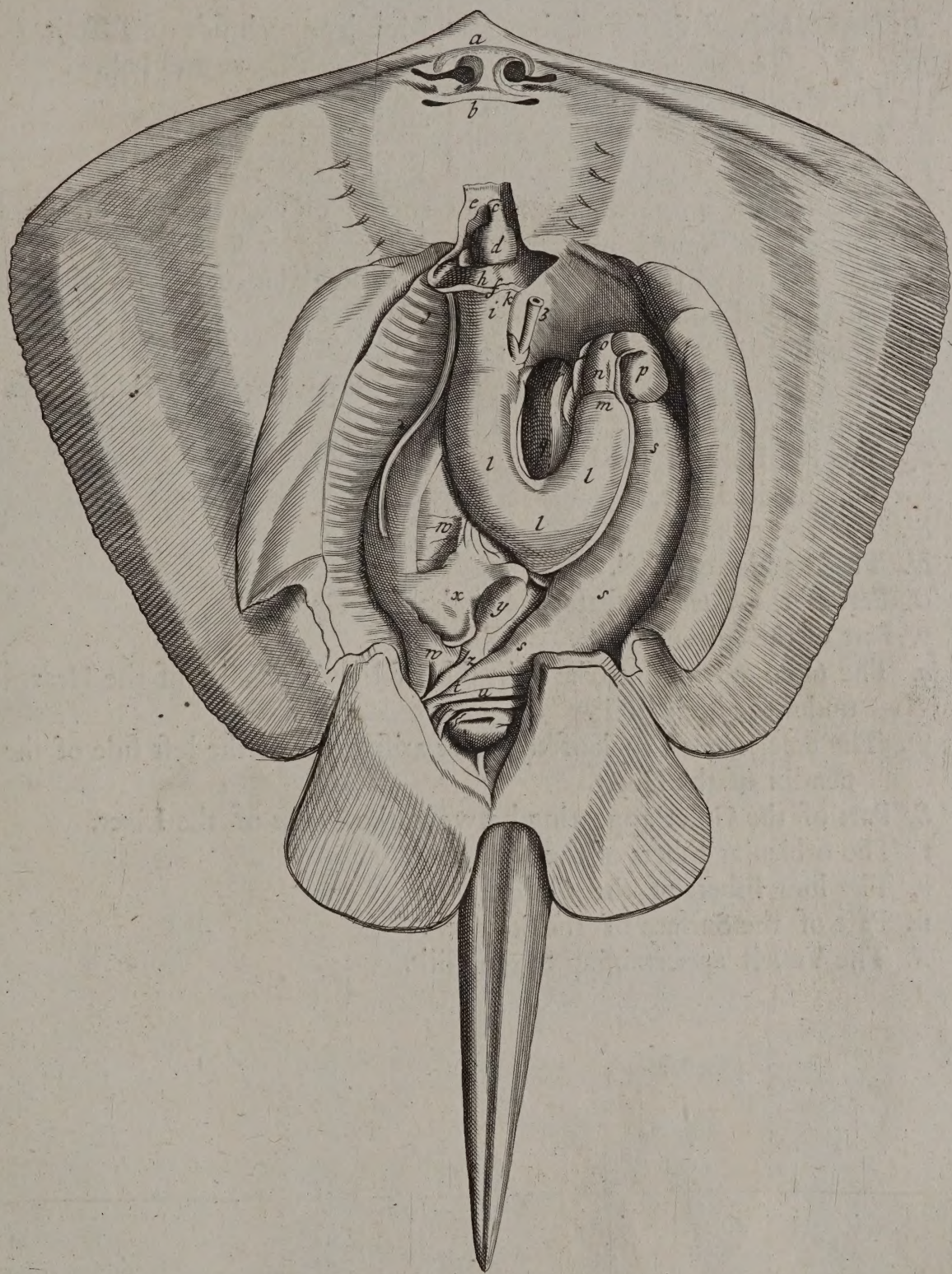
Tab. XXVIII.

Fig: 1.



Tab. XXVIII. *A Fireflaire opened,*

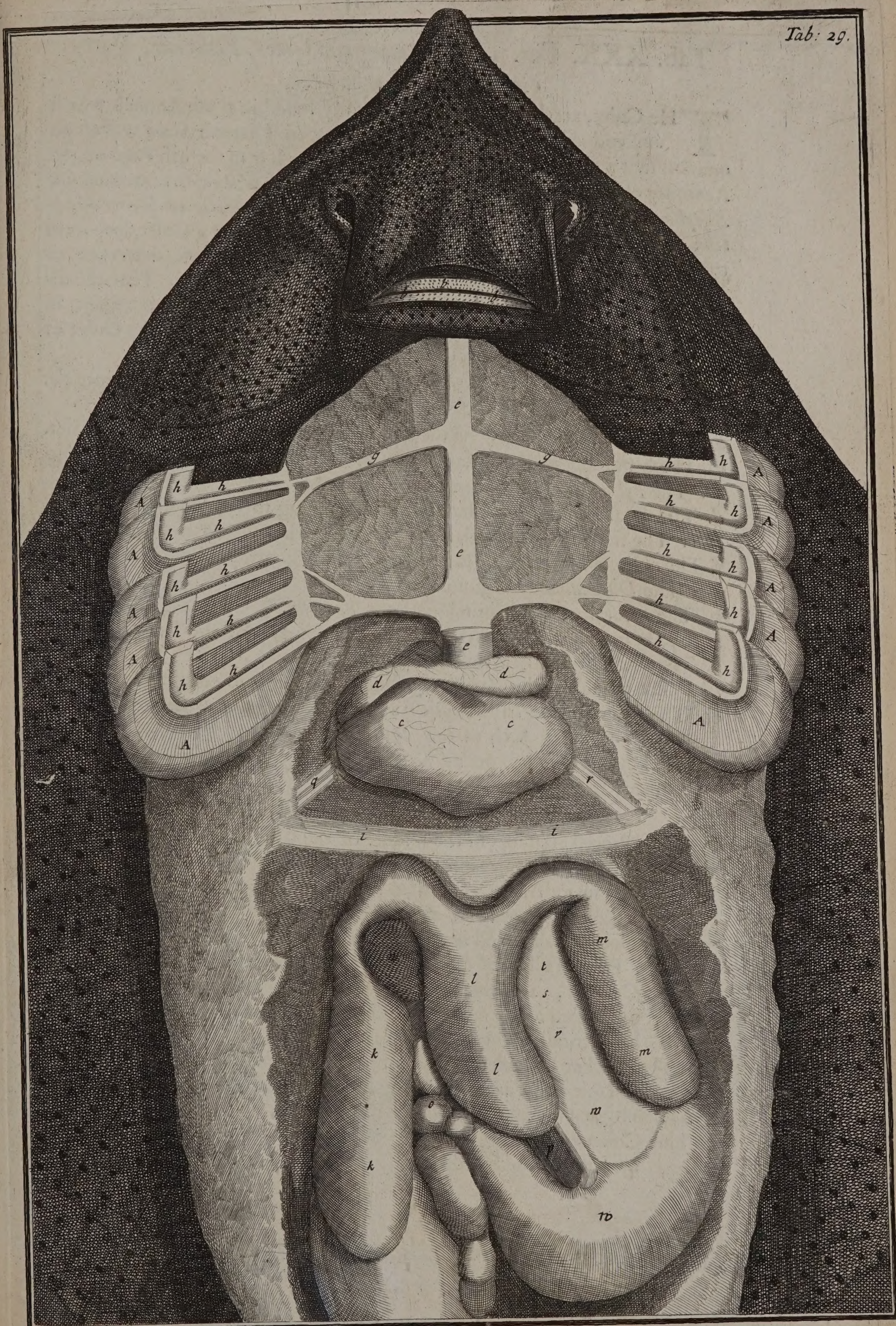
- a a.* **T**HE cover of the Nostrils.
b. The Mouth.
c. The Trunk of the *Aorta*.
d. The Heart.
e. The right Auricle lying under the lower region of the Heart.
f. Part of the Membrane encompassing the cartilaginous Arch † (part-
† *g.* ed in the middle, to give sight to the Heart) is Concave toward the
lower Venter, and Convex toward the upper.
h. The top, or origen of the Gullet, much broader then the rest, and af-
ter groweth narrower, as it approacheth toward the Ventricle.
i. The Gullet.
k. The Left Orifice of the Stomach.
l l l. The circumference of the Stomach representing an Arch.
m. The Right Orifice of the Stomach.
n. The beginning of the *Duodenum*, or great Gut, having a narrow Neck.
o. The turn of the *Duodenum*, where the *Pancreas* beginneth.
p p. The *Pancreas* arising near the turn of the *Duodenum*, inserteth it self
into the inside of the Right Gut, and that part of the *Pancreas*,
that lieth under the *Duodenum* is of a kind of triangular Figure.
q. The Spleen lying within the circumference of the Arch of the Stomach.
r. The ridge of the Spleen.
s s s. The great Gut lying in the Right Side.
t. The *Intestinum rectum*.
u. The termination of the *Intestinum rectum*.
w. The part of the Gut that lieth in the Left Side.
x. The Milte, consisting of numerous minute Glands, and Vessels.
y. The Kidney consisting of many Red Glands, interspersed with white
Membranes.
z. The Ureter discharging it self into the *Intestinum rectum*.
1. The descendent Trunk of the Artery, lodged near the Spine in the Left
Side.
2. The Artery seated in the Left Side, derived from the descendent Trunk
of the *Aorta*, and passing the length of the Milte, transmitteth many
Branches into the minute Glands of it.
3. The ascendent Trunk of the *Vena Cava*, climbing all along near the
Spine.
4. The termination of the Intestine (seated in the Left Side) to which are
affixed a company of white minute Glands, all joyned together by
thin small minute Membranes.



Tab. XXIX. *The Viscera of a Skait, &c.*

- A. **T**He Nostrils seated above the Mouth on each side of a Skait.
B. The Mouth with three rows of Teeth above and below.
C. The Heart being endued with a Pyramidal figure.
d. The right Ventricle running cross-wise under the Heart.
E. The common Trunk arising immediately out of the Heart.
F. The first and Tripartite branches sprouting on each side out of the common Trunk, and inserted into the three lower Gills.
G. The Bipartite Branches emitted on each side out of the Arterial Trunk, implanted into the two upper Gills.
H. The five Gills seated on each side.
I. The Cartilaginous Intersepiment or Wall parting the Middle from the lower Apartment.
K. The left Lobe of the Liver.
L. The middle Lobe.
M. The right Lobe.
N. The Bladder of Gall.
O. Part of the *Pancreas* seated upon the first Gut.
p. Part of the Spleen.
q. The *Cava* entering into the right side of the Appendix of the Heart lying under the body of it.
R. The descendent Trunk of the *Aorta* arising out of the left side of the Appendix of the Heart.
S. Part of the Gullet appearing between the Lobes of the Liver.
t. The orbicular Fibers of the Gullet.
u. The long Fibers of the Gullet.
w. Part of the Surface of the Stomach.
A. The Vessels appertaining to the Gills.
-

Tab. XXX.



Tab. XXX. Fig. 1. *Containing the Gullet, Ventricle, Pancreas, &c. of a Skait.*

THe Gullet, according to *Aristotle*, is only found in those Animals which are endued with Respiration, whereupon Learned *Steno* was of an opinion that a Skait had no *Æsophagus*, as he hath it in the 4th Page of the Anatomy of a Skait; His words are these, treating of a Skait, *Orī continuus sine Æsophago Ventriculus unam eandemq; cum illo in mortuis videtur conficere cavitatem*, The Ventricle being continued to the Mouth without a Gullet, doth seem to make one and the same cavity with it in dead Fish. With deference to this Learned Author, I take the boldness to make this Reply, That the dimensions and form of the Gullet and Stomach are very different in a Skait, in which the *Æsophagus* in this Fish holdeth much Analogy with the Gullet of other Animals (having Respiration) in point of Figure.

- AA.* The Gullet adorned with a round figure and much less then the Ventricle.
- aaa* The annular Fibers of the Gullet, so called as encircling it.
- bb.* The oblong Fibers making their progress through the length of the Gullet.
- C.* The beginning of the Stomach.
- D.* The *Pylorus* or termination of the Stomach.
- d.* The great Branches of Blood-vessels belonging to the Stomach.
- EE.* The transverse or circular Fibers dressing the first Coat of the Stomach.
- f.* The oblique Fibers of the second Coat of the Stomach passing in bevil lines.
- gg.* The *Duodenum* or beginning of the Guts.
- h.* The greater part or beginning of the *Pancreas*.
- i.* The branches of Blood-vessels shading the Surface of the *Pancreas*.
- k.* The smaller parts or termination of the *Pancreas*.
- lll.* The branch of the *Porta* encircling the lower region of the Stomach.
- m.* The Spleen being endued with a livid Colour, and a triangular Figure, is seated in an Arch of the Stomach.
- nn.* The Milte being dispoiled of its Coat, may be seen to be composed of many small Glands.

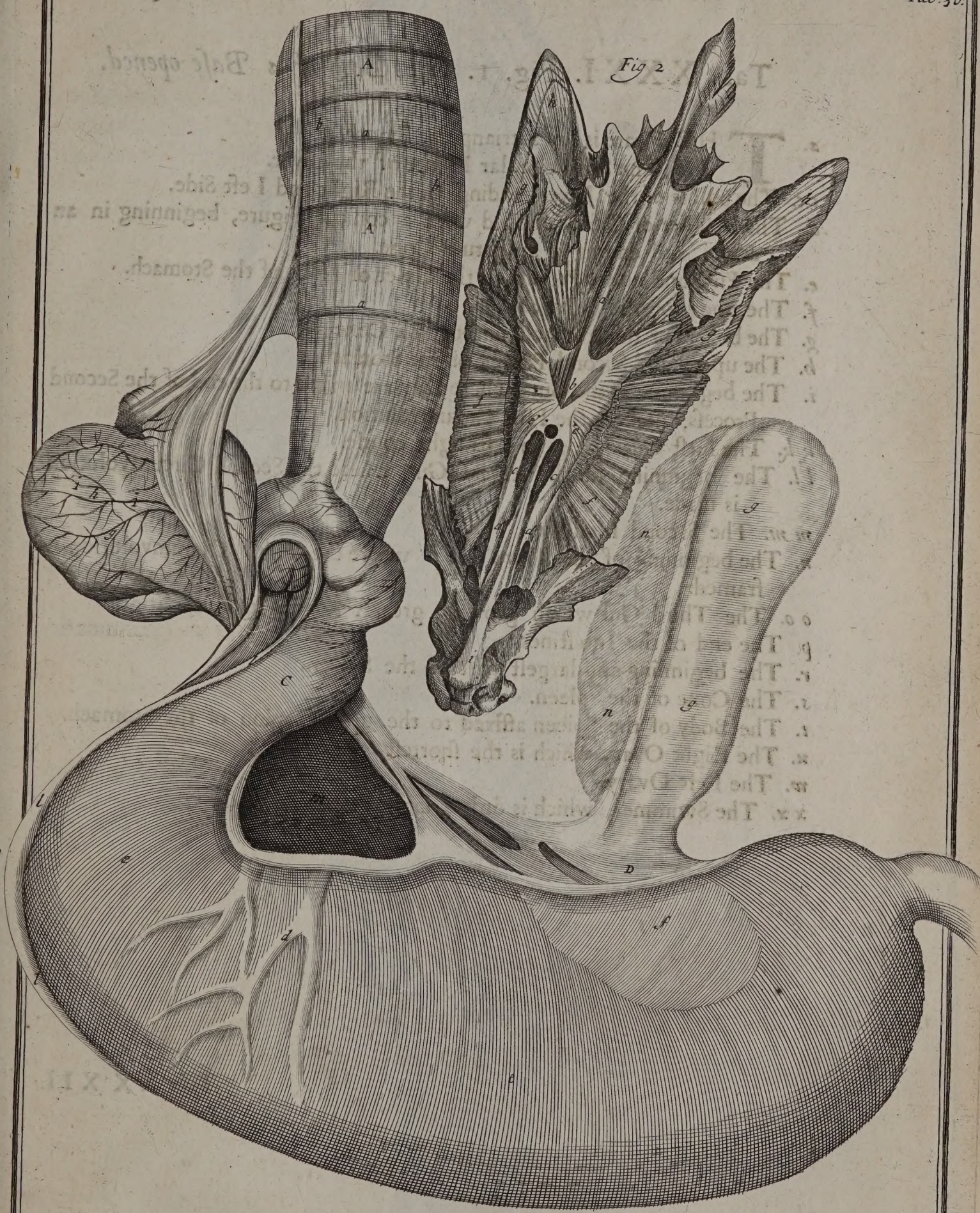
Fig. 2. *The Skull of a Cod.*

- aa.* The Process running in the middle of the Skull, is endued with a thin
- † bb.* edge, and terminates into a Sword-like Bone *†*, being a thin Expansion ending into a Angle, carried an inch and half beyond the *Occiput*.
- cc.* Two Cavities seated on each side of the Ridg, beset with divers
- † dd.* oblong Creces, and end into two pointed Processes *†*.
- ee.* The Processes being styled Lateral, as placed on each side of the Cavities, are carried all along the sides of the Nostrils, (and conjoynd to the middle Process) guarded on each side with Wing-
- † ff.* like Processes *†*, made up of many bony Fibres.
- gg.* Two thicker Processes do guard the lateral Processes, and are conjoynd in their Origins to the Wing-like Processes, and end into two Mam-
- † hh.* miform Processes *†*.
- i.* The Column fortifying the Base of the Skull, in reference to violent motions of the Head.

Tab. XXXI.

Fig. 1.

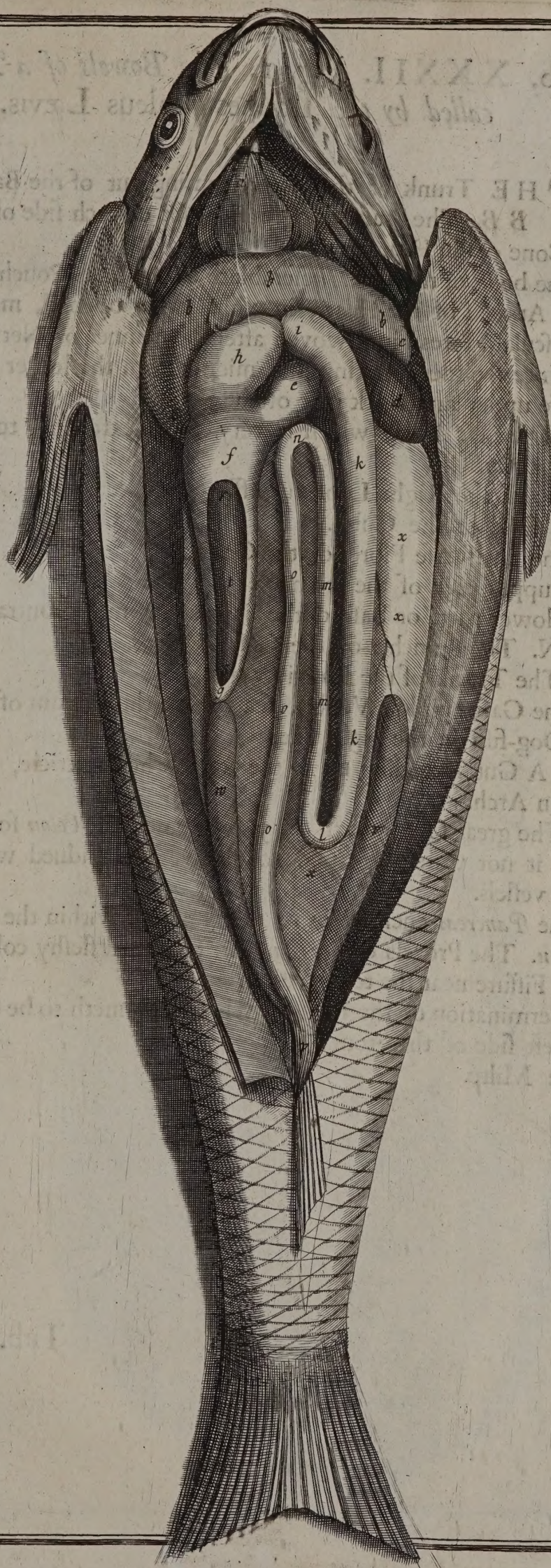
Fig. 2.



Tab. XXXI. Fig. 1. *The Body of a Base opened.*

- a.* **T**HE Heart is of a triangular Figure.
b b. The Semi-circular Figure of the Liver.
c c. The points of the Liver, ending in the Right and Left Side.
d. The Bladder of Gall is endued with a conical Figure, beginning in an acute, and ending in an obtuse Cone.
e. The First and under Process, is the Gullet or Neck of the Stomach.
f. The Body of the Stomach.
g. The botom of the Stomach ending in a Cone.
h. The upper and Second Process of the Stomach.
i. The beginning of the Guts, where they are united to the end of the Second Process, maketh the First Circumvolution.
k k. The First Gut going in a straight course.
l l. The beginning of the Second Gut, where the Second Circumvolution is made.
m m. The Second Intestine.
n. The beginning of the Third Gut, where the Third Circumvolution is framed.
o o. The Third Gut which groweth greater toward its termination.
p. The end of the Intestines.
r. The beginning and largest part of the Spleen.
s. The Cone of the Spleen.
t. The Body of the Spleen affixed to the upper region of the Stomach.
u. The Right Ovary which is the shortest.
w. The Left Ovary.
x x. The Swimmer, which is only a large one in this Fish.

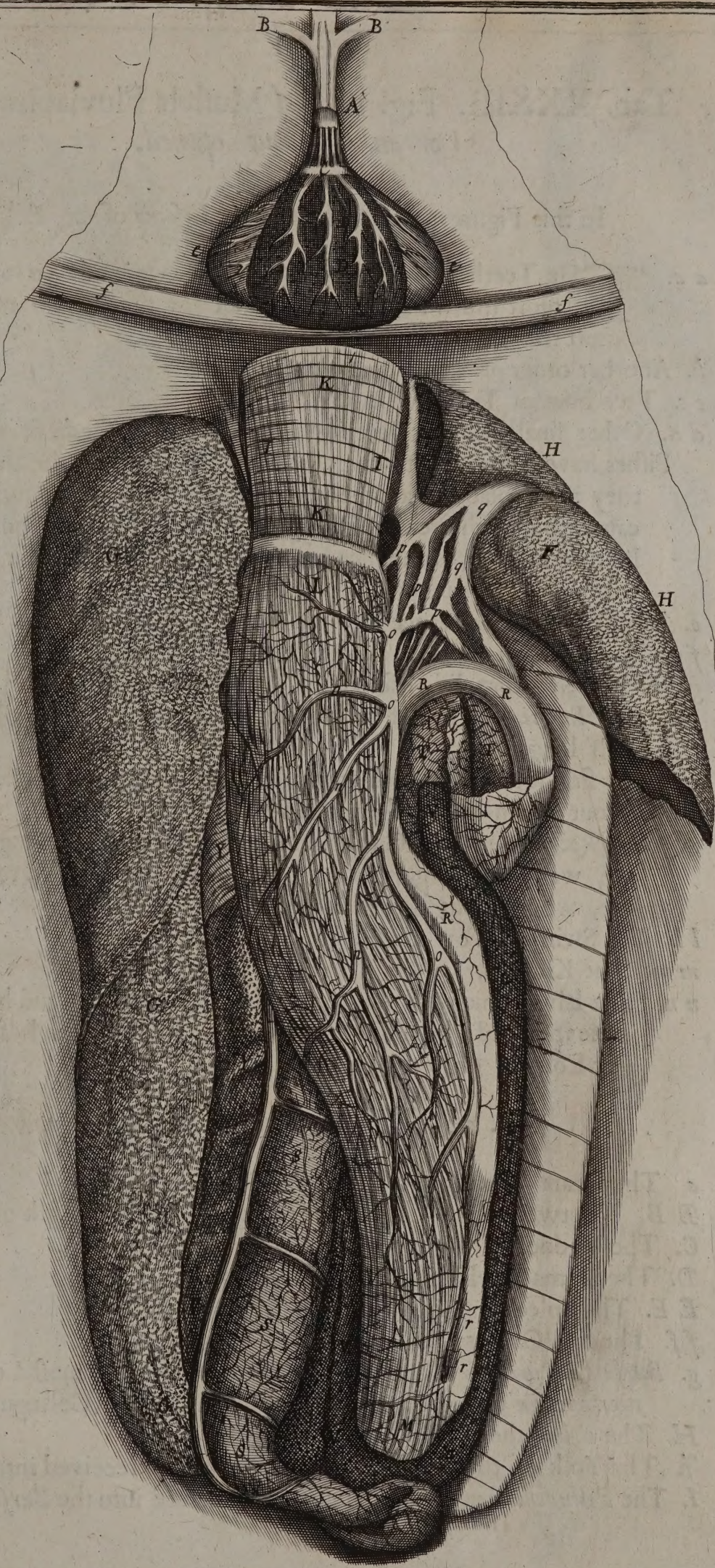
Tab. XXXII.



Tab. XXXII. Fig. 1. *The Bowels of a Dog-Fish,*
called by the Latines Galeus Lævis.

- A.** **T**HE Trunk of the *Aorta*, coming out of the Base of the Heart.
B B. The Branches springing out of each side of the *Aorta*.
C. The Cone of the Heart.
D D. The body of the Heart resembleth a Shepherds Pouch.
e e. The Auricle of the Heart, in which being opened, may be seen many muscular Fibres, interwoven after the manner of Network.
f f. An Intersepiment parting the middle from the lower Venter.
F F. The upper and thick part of the Liver.
G G G. The Left Lobe which is very long, extended to the end of the *Colon*.
H H. Part of the Right Lobe cut off.
I I. The sides of the Gullet.
K K. The transverse Fibres of the Gullet.
L. The upper part of the Stomach.
M. The lower part, or Base of the Stomach is more contracted.
NNNN. The Branches of the Gastric Veins.
o o o o. The Trunk of the Gastric Veins.
Q Q. The Gastrepiploic Vessels, seated near the bottom of the Stomach in a Dog-fish on the right side.
R R R. A Gut ascending up to the top of the Ventricle, and there maketh an Arch.
S S S. The great Gut, which may be termed the *Colon* for greatness, (did it not want the connivent Valves) is endued with large Blood-vessels.
T T. The *Pancreas* enclosed in its upper region within the Arch of the Gut.
u u u u u. The Process of the *Pancreas* of a Red fleshy colour.
w. The Fissure near the termination.
x. The termination of the Process, where it seemeth to be inserted into the Left side of the Stomach.
y y. The Milte.

Tab. XXXIII.



Tab. XXXIII. Fig. 1. *A Mustela Fluvialis Barbata,*
or an Eel-pout opened.

In this Figure are represented the *Viscera* of an Eel-pout.

- a a.* **T**He Teeth in the upper Jaw, which were of two sorts, the outermost much the largest, and set at a greater distance, the innermost much lesser and closer set.
- b.* Another order of Teeth in the upper Jaw.
- c c.* Two burs of Teeth set in the Throat.
- d d.* Other small burs of Teeth set on the Bones or *Radii* of the Gills.
- Fishes have Teeth not to chew, but to catch and retain their Prey, and they are so placed with their Hooks or Extremities inward, that they cannot but with great difficulty loose what they have once got hold of; Nature making abundance recompence by their number for what single they want in strength.
- e.* The Throat or entrance into the Stomach.
- f f.* The Stomach which was almost three inches long.
- g.* The *Pylorus* that did arise out of the side of the Stomach.
- h h.* The *Intestina Cæca*, of which there were about 17 or 18, an Inch and half long.
- i i.* The first Intestine which from the *Intestina Cæca*, to the *Rectum*, was about ten Inches, making one Flexure.
- K.* The *Rectum* or other Gut about two Inches and half long, when blown up, was as large again as the former Gut, and made a remarkable Flexure, where 'twas joyned fast.
- l l.* The Swimmers or Air-bladders.
- m m.* The Kidneys.
- n n.* The Liver which was white and about three Inches and half long, about one Inch and $\frac{1}{4}$ broad, but at the top, where it sends forth a Process or Lobe at (o) 'twas an Inch and $\frac{1}{4}$.

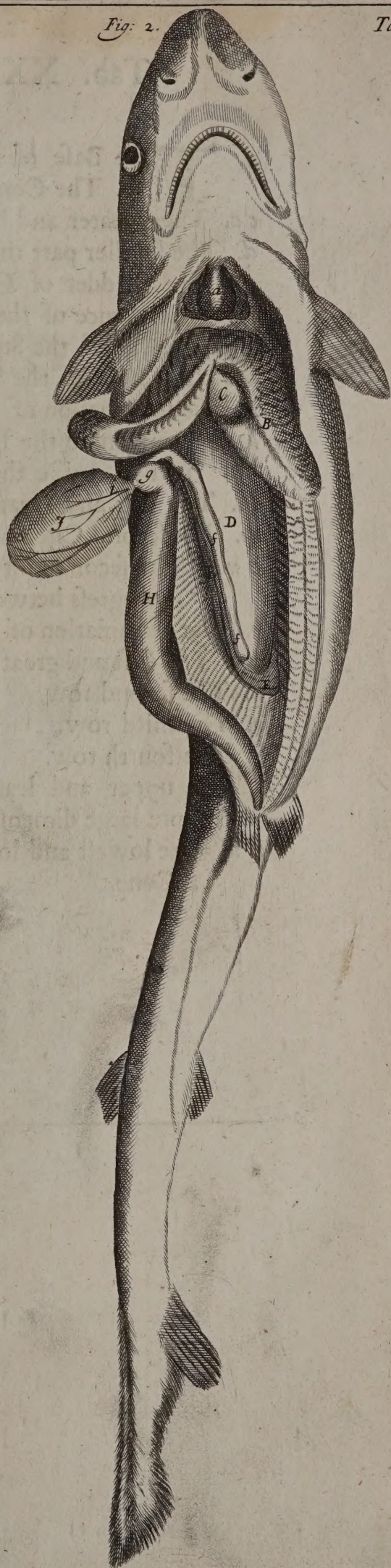
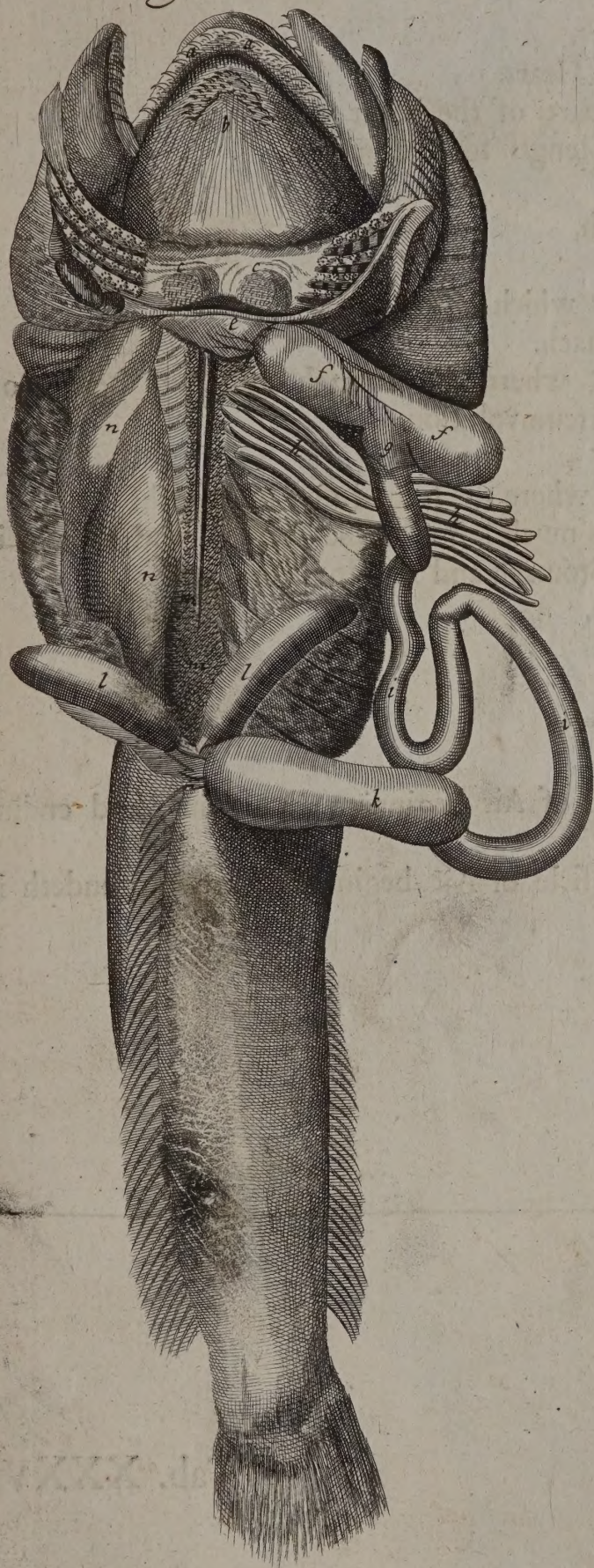
Fig. 2. *The Embryo of a Dogfish opened.*

- a.* The Heart resembling a Shepherd Pouch.
- B B.* The two Lobes of the Liver passing the whole length of the *Abdomen*.
- C.* The bladder of Gall.
- D.* The Stomach which was of a great length.
- E E.* The Spleen.
- f f.* The first Gut or *Duodenum*.
- g.* *Bursa Entiana*, so called because first discovered by most Learned and Renowned Sir George Ente, my worthy Friend and Colleague.
- H.* The Colon, the last and great Gut.
- f.* The Yolk of the Egg, which in this Fish was received into the Belly.
- I.* The *Pedunculus* or *Ductus Intestinalis*, inserted into the *Bursa*.

Tab. XXXIV.

Fig. 2.

Fig. 1.



Tab. XXXIV. *The Body of a Bream opened.*

- a.* **T**He Base of the Heart.
b. The Cone of the Heart.
c c. The greater and broader part of the Liver.
d. The smaller part running in length for some inches.
e e. The Bladder of Gall.
f. The entrance of the Stomach.
g. The Arch of the Stomach.
h h. The Body of the Stomach, which is very long.
i. The termination of the Stomach.
k. The origen of the Intestines, where the Stomach and Guts being con-
joyned, make the first Circumvolution.
l l. The first and greater Gut.
m. The second Circumvolution where the second Gut beginneth.
n n n. The second Gut which is much less then the former, and taketh its
progress between the Stomach and first Intestine.
o. The termination of the Guts.
p p. The first and great row.
q. The second row.
r. The third row.
s. The fourth row.
t. The upper and least Vesicle of Air beginning in a point, and ending
more large dimensions.
u u. The lowest and longest Vesicle of Air beginneth large and endeth in
a Cone.
-

Tab. XXXV.



Tab. XXXV. Fig. 1. Of a Pope opened.

- T**HE great Trunk of the Artery.
b. The body of the Heart.
c. The Cone of the Heart, which may be resembled to one part of the cloven Foot of a Deer.
d. The entrance into the Gullet.
e. The Gullet or Neck of the Stomach.
f. The body of the Stomach.
g. The bottom of the Stomach.
i. The termination of the Stomach.
k. The beginning of the Guts, where it immediately maketh a Mæander, and goeth down for some short space, and then maketh a Circumvolution.
l. The first Circumvolution, and then ascendeth for an Inch, and maketh another Circumvolution.
m. The Second Circumvolution, and passeth down in a straight course between the Ovaries to the Vent.
nn. The two Ovaries, which discharge themselves into the *Intestinum rectum*, near the Vent.
oo. Part of the Liver turned up.

Fig. 2. The Body of a Perch opened

- a.* The entrance of the Gullet, which is large.
b. The Gullet, or Neck of the Stomach.
c. The Body of the Stomach.
d. The beginning of the Intestines.
ee. Two *Intestinula Caca* seated on each side of the Origen of the Guts.
f. The first Circumvolution of the Guts, beginning immediately after the *Pylorus*, and goeth in a straight course for an Inch or more, and then maketh a Circumvolution.
g. The Second Mæander of the Intestines, mounting up for some space, and then maketh a third Circumvolution, and afterward passeth in a straight course between the Milt.
hh. The Milt placed on each side of the Intestines.
ii. Part of the Liver seated in the Left Side.
k. The Bladder of Gall placed in the Right Side.

Fig. 3. The Body of a Smelt opened.

- a.* The Heart being as in other Fish, of a triangular Figure.
bb. The Liver being of an Ash-colour, hath its Origen broad, and is a little parted toward the Right Side, where it hath a small pointed Process.
c. The Origen which is broader then the rest of the Liver.
d. The small pointed Process on the top of the Liver.
ee. The Gullet, or Neck of the Stomach, seated in the Left Side, and the Process climbing up the Right Side, maketh an Arch with the body of the Stomach, and is like a Pike, larger above, and endeth in an obtuse Cone.
ff. The Process sprouting out of the Right side of the Body of the Stomach, which determineth near the *Pylorus*.
g. The *Pylorus*, or termination of the Stomach, where the Gut begins.
h. The Origen of the Guts makes a short Circumvolution and then goes down between the Sides of the Arch for some space, and afterward creepeth under the Process of the Stomach and then maketh its progress almost in a straight line.
ii. The straight course of the Guts, from their turning above, to the *Anus* below.
kk. The Bladder of Gall being of a Brownish colour, and very large (considering the smallness of the Fish) is affixed to the Concave part of the Liver, as in other Animals.

Fig. 4. The Body of a Gudgeon opened.

- a a.* The Heart of a Triangular Figure.
b. The Auricle of the Heart lying under it, in a supine posture, runneth cross the *Thorax*.
c. The Gills.
dd. Part of the Liver put out of its proper situation.
ee. The Stomach seated in the Right Side, is larger and narrower toward its termination where it is conjoynd to the beginning of the Guts.
ff. The Guts begin in a short Mæander, and then climb up toward the beginning of the Stomach, where the Second begins, making a short Mæander, and then passeth in a straight line.
gg. The termination of the Guts near the Left Side.
i. The vesicle of Gall being of a Black colour, is seated in the right Side, in the concave part of the Liver.
kk. The hard Rows, or Ovaries seated on each side of the Guts.
ll. The Swimmer, or Bladder of Air.
m. The Spleen of a Red colour, and pyramidal Figure.

Fig. 1.

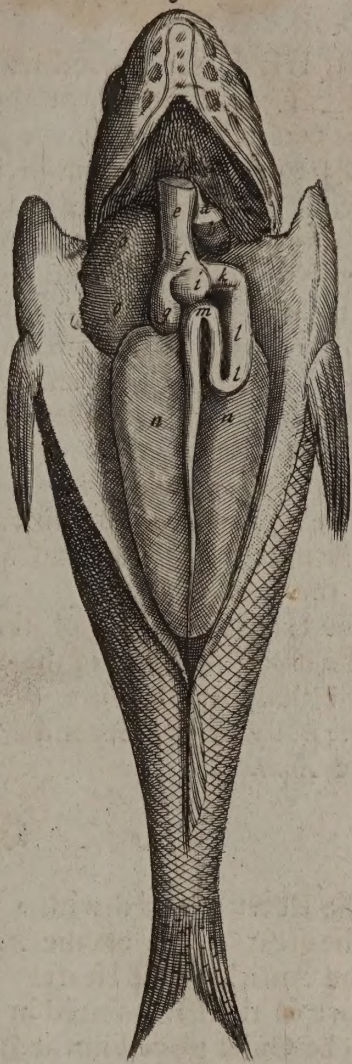


Fig. 2.



Fig. 4.

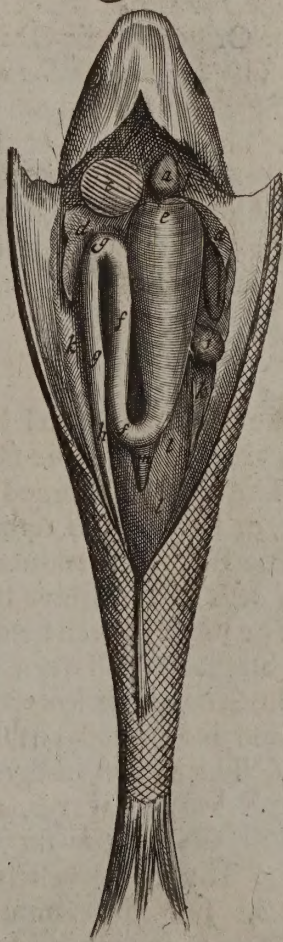
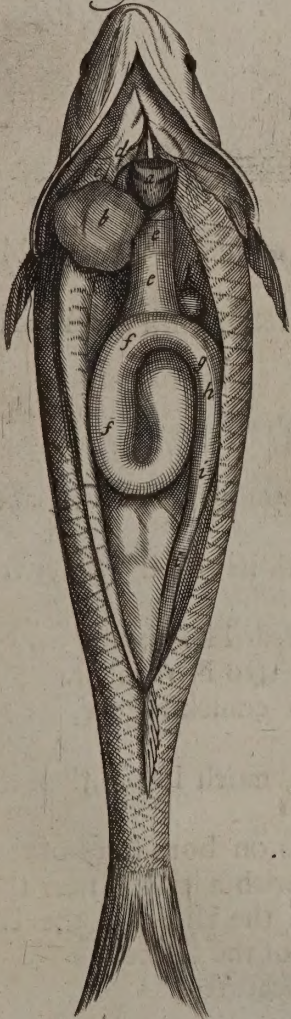


Fig. 3.



Tab. XXXVI. Fig. 1. *The Bowels of a Grey Mullet.*

- a. **T**HE Heart endued with a triangular Figure.
- b. The Auricle of the Heart out of its situation.
- c. The common Trunk of the great Artery.
- d d. Part of the Liver out of its situation.
- e. Part of the Gullet, adorned with a round Figure.
- f. The Body of the Stomach, beautified with a circular Figure in its outward circumference, containing within it another Circle, and both are beautified with many transverse Fibres.
- g. A round Cavity lodged in the center of the Stomach, encircled with transverse carnosus Fibrils.
- h. The *Fundus*, or bottom of the Stomach, terminating into an acute Cone.
- i i. The *Intestinula Caca* affixed to the Origen of the Guts.
- k. The beginning of the Intestines.
- K K. The Spleen hued with a dark Red, and endued with a conick Figure.
- l l l. The Guts making many Mæanders.
- m. The long neck of the first Milte implanted into the Gullet.
- n. The neck of the Second Milte, implanted into the Poke or Process of the Stomach, below the Body of it.
- o. The excretory Ducts of the First Milte, inserted into the *Intestinum rectum*, near the *Anus*.
- p. The excretory Duct of the Second Milte, ending as the First.
- q. The Body of the Milte (lodged near the Left side.)
- r. The Body of the Second Milte (seated near the Chine) beginning and ending in a Cone.
- s. The *Anus*.

Fig. 2. *The Bowels of a Red Mullet.*

- a. The Heart adorned with a triangular Figure.
- b. The great Trunk of the *Aorta*.
- c. The Auricle of the Heart.
- d. Part of the Liver seated in the Left side.
- e e. The Gullet placed in the Left side.
- f. The Body of the Stomach seated in the Left side.
- G. The Body of the Stomach placed in the Right side.
- g. The bottom of the Stomach terminating into a Cone.
- h. The *Pylorus*.
- i. The Origen of the Guts, making a Circumvolution.
- k k. The *Intestinula Caca* affixed to the *Duodenum*.
- l. The Second Mæander of the Intestines, which is very short.
- m m. The great Gut ending into a double Branch.
- n. The First, or upper Spleen is seated near the Stomach, and endued with an oblong round Figure, and hued with a Purple colour.
- o. The Second and lower Spleen is somewhat more large, and dressed with a conick Figure.
- p p. The hard Rows, or Ovaries, consisting of many Eggs.

Fig. 3. *An Eel opened.*

- a. The Heart of an Eel beautified with a Conick Figure, beginning in an acute, and terminating into a more obtuse Cone.
- bb. The Liver is adorned with a bright Yellow colour, and taketh its rise in two little Processes or Heads, and terminates into a kind of Cone.
- C. The Bladder is endued with a deep Blue colour, and with a Pear-like Figure.
- d d d d. The Guts have but one Circumvolution, and seem to be two in number.
- E. The upper Spleen being of a dark colour, is beautified with a conick Figure, and seated between the Guts, near the Circumvolution.
- e. The Second, or lower Spleen is seated between the two Guts, much lower then the former, and is adorned with an Oval Figure.
- ffff. The Kidneys beginning near the Guts, take their progress on both sides of the Spine in various waves, and have their lower Extremity endued with a point, near the termination of the *Intestinum rectum*, into which they discharge the Urine by the Ureters.
- g g g g. The Blood-vessels descending all along on the right side of the Spine.
- h h h h. The Milte running on each side of the Guts in many plicatures.
- i i i. The Spine passing between the Kidneys all down the Back.
- k. The *Anus*, or termination of the *Intestinum rectum*.

Fig. 1

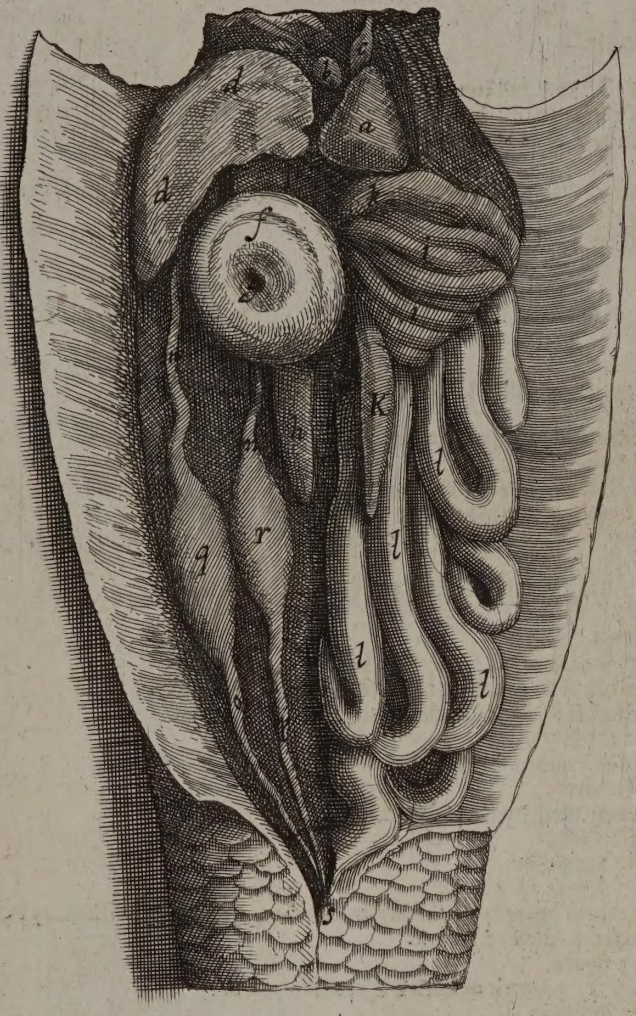


Fig. 2

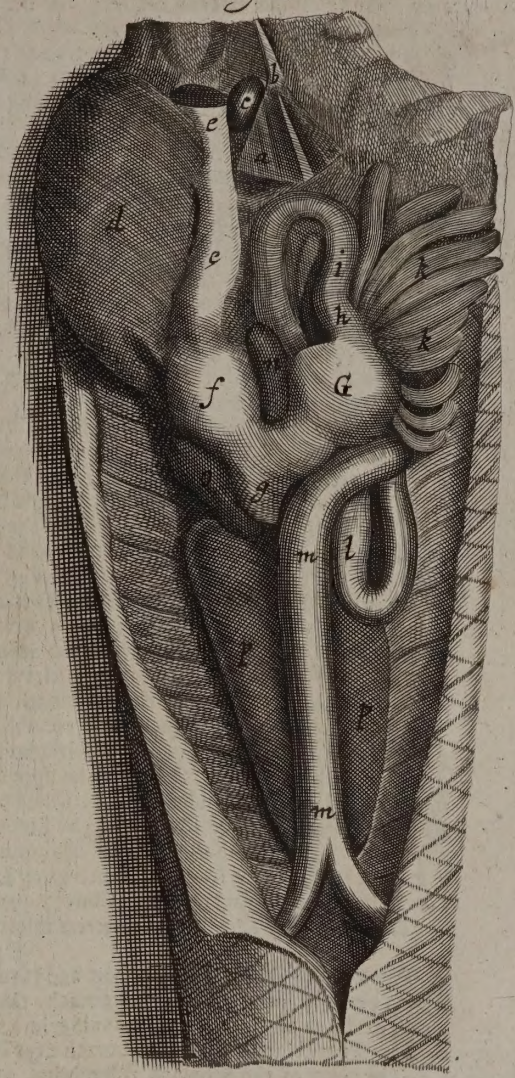
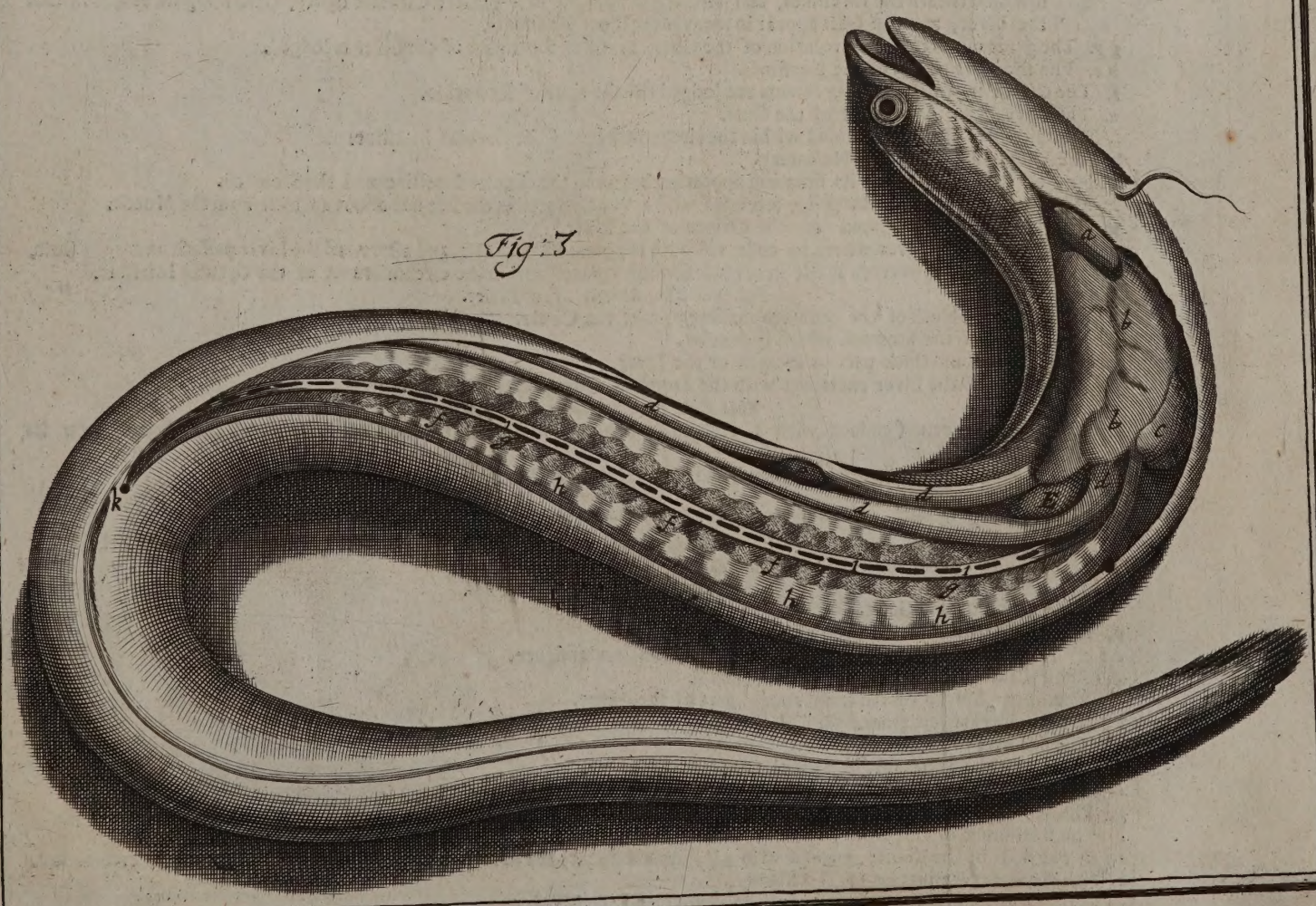


Fig. 3



- T**he Gullet or Neck of the Stomach seated on the left side.
bb. The body of the Stomach.
cc. The termination or bottom of the Stomach ending in a Cone.
ddd. The *Intestinula Caca* turned up, which are three, conjoynd by the mediation of Membranes, and in the natural situation do lie upon the beginning of the Guts.
eee. The Intestines descend the length of the Body, and have three Circumvolutions.
f. The right Process of the Stomach which joyneth to the origen of the Intestines.
g. The Vesicle of Air, commonly conceived the Bladder, by which the Fish swimmeth.
hh. The transverse Fibres of the Vesicle of Air.
i. The Muscle of the Vesicle of Air running long-ways.
kk. The Ovaries seated on each side.
ll. The termination of the Kidneys lodged near the end of the Intestines.
m. Part of the Liver put out of its natural situation the better to discern the Stomach.

Fig. 2. *The Bowels of a Whiting.*

- a.* The Gullet seated in the left side.
b. The Process arising out of the body of the Stomach, bendeth toward the right side, and there is conjoynd to the origen of the Intestines.
cc. The body of the Stomach beginning large and ending small.
d. The Cone or termination of the Stomach.
D. The Spleen adjoyning to the Stomach.
ee. The *Intestinula Caca* lifted up out of their proper place, in which they cover the Gullet and Process of the Stomach both above and below.
ff. The Gut descending on the left side in several windings.
gg. The Sounds being large in their origen near the Head and smaller toward their termination.
hh. The transverse Fibers or Filaments of the Sounds.
iii. The Liver descending down the left side being broader above and narrower below.
kk. The Seam going down the middle of the Liver long-ways.
ll. The *Intestinula Caca* lodged between and under the Gullet and Process of the Stomach.

Fig. 3. *The Bowels of a Turbat.*

- aa.* The entrance of the Stomach of a Turbat turned up, which is very large, consisting in the inside of many folds.
bb. The Folds seated in the inside of the entrance of the Stomach.
C. The lower Spleen seated between the Stomach and Guts, and is hued with a deep Red.
ccc. The Stomach running in a Semicircular figure.
d. The Pylorus conjoynd to the termination of the Great Gut.
ee. The beginning of the Intestines resembling another Stomach.
fff. The Intestines run round in a Circular figure, and begin large and grow less and less a great way.
gg. The end of the Guts seated in the upper part of the left side not far from the head.
h. The *Cacum* an Appendix fastned to the beginning of the Guts.
F. The upper Spleen adjoyning to the Liver being endued with a florid Red.
i. Part of the Liver fastned to the beginning of the Stomach.
kk. The Liver parted by Fissures into many Lobes, encompassed by the Circular Intestine.
ll. The *Pancreps* adjacent to the Convex part of the Stomach.
m. The Excretory Duct of the *Pancreas* inserted into the Stomach.

Fig. 4. *The Bowels of a Prill.*

- a.* The Mouth of the Gullet cut open and turned up, in which being large the inward Surface is furnished with many Folds.
bb. The Gullet or Neck of the Stomach, that conveyeth the Aliment into it.
cc. The body of the Stomach running in a Semilunary figure.
d. The Protuberance of the Stomach near its termination, where it maketh a Circumvolution.
ee. The body of the Stomach resembling a Semicircle in figure.
f. The winding of the Stomach near its termination and conjunction with the Origen of the Intestines, which goeth first underneath the Intestines, and afterward appears in a greater Circular figure, containing three Globules of the Liver, and the Guts appear in many more short Mæanders.
gg. The great circular Circumvolution of the Guts, in which some part of the Liver is lodged.
hh. The short Mæanders of the Intestines.
i. The *Cloaca* in which the Excrements are lodged till the time of Excretion.
n. The *Cacum*, an Appendant of the Guts.
l. The Globules of Liver enclosed within the circumference of the circular Intestine.
o. The Vessels Enameling the Mesentery.
q. Part of the Spleen out of its situation appearing between the circular Intestine and the Stomach.
R. The termination of the Intestines attended with a Vent, seated in the left side about an Inch from the Mouth.
m. The Bladder of Gall seated near the Origen of the Liver.
p. The Origen of the Liver where its endued with the greatest thickness, and afterward the Liver passeth under the Guts, and at last discovereth it self in diverse Globules placed within the circumference of the circular Intestine.

Fig. 5. *The Bowels of a Plaice.*

- aa.* The Gullet or Neck of the Stomach making part of the Circle.
bb. The Body of the Stomach which is circular.
cc. The narrow and thick part or Origen of the Liver.
dd. The body of the Liver encircled with the Stomach ending broad and thin.

This Fish hath a double Spleen.

- a.* The upper Spleen (endued with a triangular Figure) is fastned to the Concave part of the Liver † near its Origen.
f. The lower Spleen is fastned to the Guts by an Excretory Duct terminating into the *Cloaca*.
ggg. The Excretory Duct.
b. The *Cloaca* or termination of the Guts near the *Anus*.
i. The Bladder of Gall hath two Excretory Ducts, the one coming from the Concave part of the Liver, and the other
† *k.* Duct † is inserted into the Stomach near its Origen.

Fig. 6. *A Flounder opened.*

- a.* The Origen of the Gullet.
b. The Gullet or neck of the Stomach.
ccc. The Ventricle which hath somewhat of a Semicircular figure.
d. The Pylorus or termination of the Stomach.
E. The upper Spleen tied to the Concave part of the Liver.
eee. The Guts and situation.
F. The Bladder of Gall.
ff. Part of the Liver (furnished with Glands) turned up.
G. The lower Spleen.
g. The Mesenterick Vessels.
h. The beginning of the Kidney which is most large.
iii. The body of the Kidney, endued with a Pyramidal figure, the Base being in its origen, and Point in its termination.
k. The Cone or termination of the Kidney.
l. The Ureter coming from the Kidney, is inserted into the Bladder.
m. The Ureter cut off.
n. The beginning of the Bladder of Urine.
o. The body of the Bladder, endued with an oblong round Figure.
p. The termination of the Bladder confining on the Vent, seated on the right side of the Fish.
qqq. The Ovaries beginning in large dimensions, and ending into a Cone, and are double, lying upon one another in the right side, and after the same manner the Milts are placed.

Fig: 1.

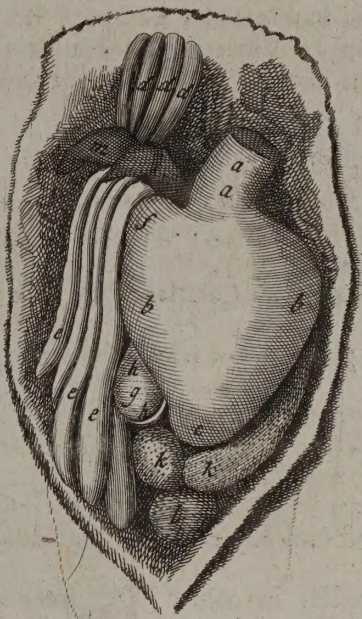


Fig: 2

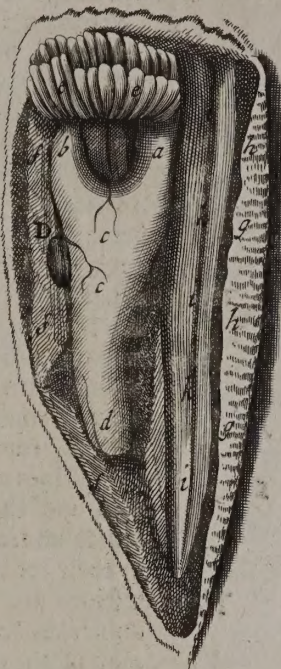


Fig: 3.



Fig: 4.



Fig: 5

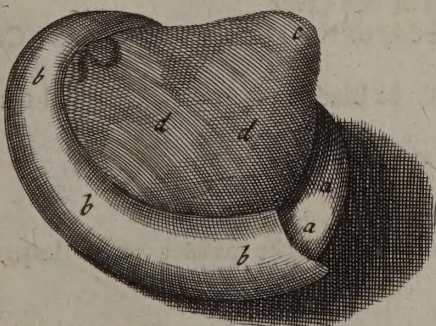
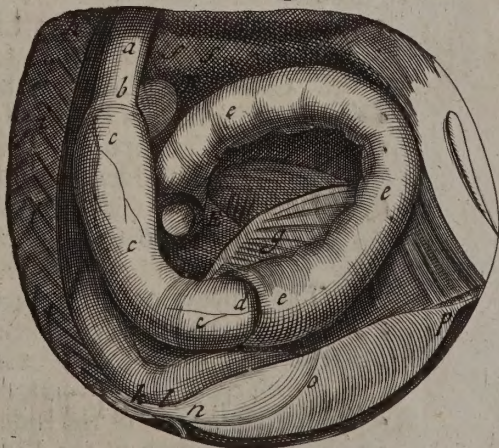


Fig: 6.



Tab. XXXVIII. Fig. 1. *The Bowels of a Lamprey.*

† a a. The Heart of a Lamprey is covered with a white Cartilaginous substance † as being the *Pericardium* resembling the form of a Heart, which is double in this Autopsy; for I saw the left Lobe, or Ventricle being often pricked, make many Vibrations, three or four every time it was wounded, and immediately after the right Lobe or Ventricle being pricked with the point of a Knife, did not make the least motion.

b. The Lobe seated in the right side of the Heart.

c. The Lobe or Ventricle placed in the left side of the Heart.

d d. The Gullet is very different from the Stomach both in thickness and length, and especially in the first entrance, and its lower Region is enwrapped with a thick glandulous substance, and is covered all over with a more thin expansion of the same nature.

The Gullet is encircled for an inch or more with a white Pyramidal Cartilage, its Base lieth near the Mouth, and its point downward.

e e. The Stomach is bigger above, and endeth into a kind of point, out of which there is a very small passage into the Guts.

f f f. The Caul is composed of many parts, enclosed with proper Membranes, and resemble the Intestines, running up and down in many Gyres, the whole length of the *Abdomen* to the *Anus*.

g g g. The Intestines in this Fish are most large in their Origen, and they pass from the right to the left side, and then make a Circumvolution, and afterward maketh its progress in a straight course under the Liver; The Intestines have greatest dimensions in their beginning, and less in their termination near the Vent.

The Intestines are of a red colour resembling Blood-vessels in colour, and are endued with numerous folds (passing the length of the Guts) which give a check to the over-quick motion of the Chyle and gross Excrements.

† h h. The Liver † of a Lamprey is destitute of Lobes, being of one entire substance, as in a Salmon, and is bigger and thicker in its origen, and endeth in a kind of point, its body covereth the upper part of the Intestines.

i i. The Globules appearing very fair in the Liver where the Coat is stripped off.

Fig. 2. *The Bowels of a Garfish.*

† a. The Heart of a Garfish is a Triangular figure (its Base † is seated upward, and its Cone † † b. downward, as in most Fish, and is lodged in a small apartment under the Tongue, which may be styled the *Thorax*, which is parted from the lower Venter by a thin membranous Diaphragm.

† c c. Under the Heart (lying in a supine posture, as most convenient for Dissection) is seated a large Auricle †, to which the *Vena Cava* is fastned, carrying Blood into the Heart.

† d. And the right side of the Auricle, hath a minute Body † somewhat of a Pyramidal figure, whose more large part is affixed to the Base of the Heart inclining toward the right side.

† e e. The Stomach † is as it were the upper part of the Intestine, or origen of it having no Plicatures, as are found in most Fish, and hath the same structure, and differeth only as somewhat bigger, and no Sphincter relating to the *Pylorus*, there being no straightness where the Stomach endeth.

† f f. The Gut † of this Fish is destitute of any Circumvolution, and maketh its progress in a straight † g. course all down the lower Venter to the Vent †.

This long Intestine hath no Valves in its inside, nor any Cells like those of a Honey-comb (which have been discovered in the single Intestine of a Sturgeon) which are instituted by Nature, as I conceive, to give many stops to the overhasty passage of the Excrements.

And the reason, I conceive, why this Fish hath but one Gut, destitute of Folds, Valves, and Circumvolutions, is, because the Ferments of the Stomach and Gut being one continued Cavity, are very spirituous, active, and full of Volatil saline parts, which can quickly colliquate the Aliment, and extract the Liquor; so that there needs no Folds, Valves, or Gyres, to give a long stay to the nourishment of easie Concoction in the Stomach and Guts.

Fig. 3. *The Liver of a Garfish.*

a a. The upper Region of the Liver which is very broad.

b b. The lower Region of the Liver which groweth less and less, and endeth in a Cone.

c. The Cone of the Liver in which it terminateth.

d d d d. The Glands besetting the upper and under Region of the Liver.

e e e e. The Ducts importing bilious Matter secreted in the body of the Liver into the greater Cavity of the Bladder of Gall.

f f. The Bladder of Gall full of small oblong Fibers, by which the Bladder is contracted, and the Oyl excerned out of its Bosome.

Fig. 4. *The Kidneys of a Gurnet.*

a a. The broader and upper part of the Spine.

b b. The progress of the Spine all along the Back, in a Pyramidal figure.

c c. The upper Region of the Kidneys, which is much expanded after the manner of an imperfect Triangle, and consisteth of two large Lobules.

d d d. The progress of the Kidneys which are very narrow.

e e. The termination of the Kidneys when they are conjoyned, which is much broader and thicker then the middle, and terminate on each side near the extremity of the Intestines into two Cornick Lobules much larger then any of the rest.

Fig. 2.

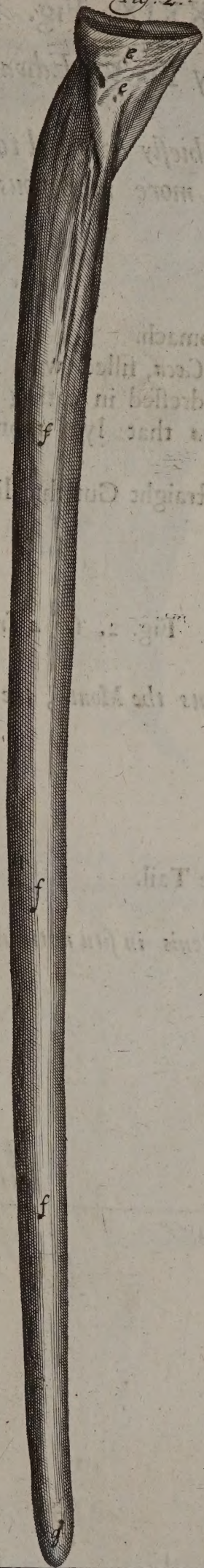


Fig. 1.

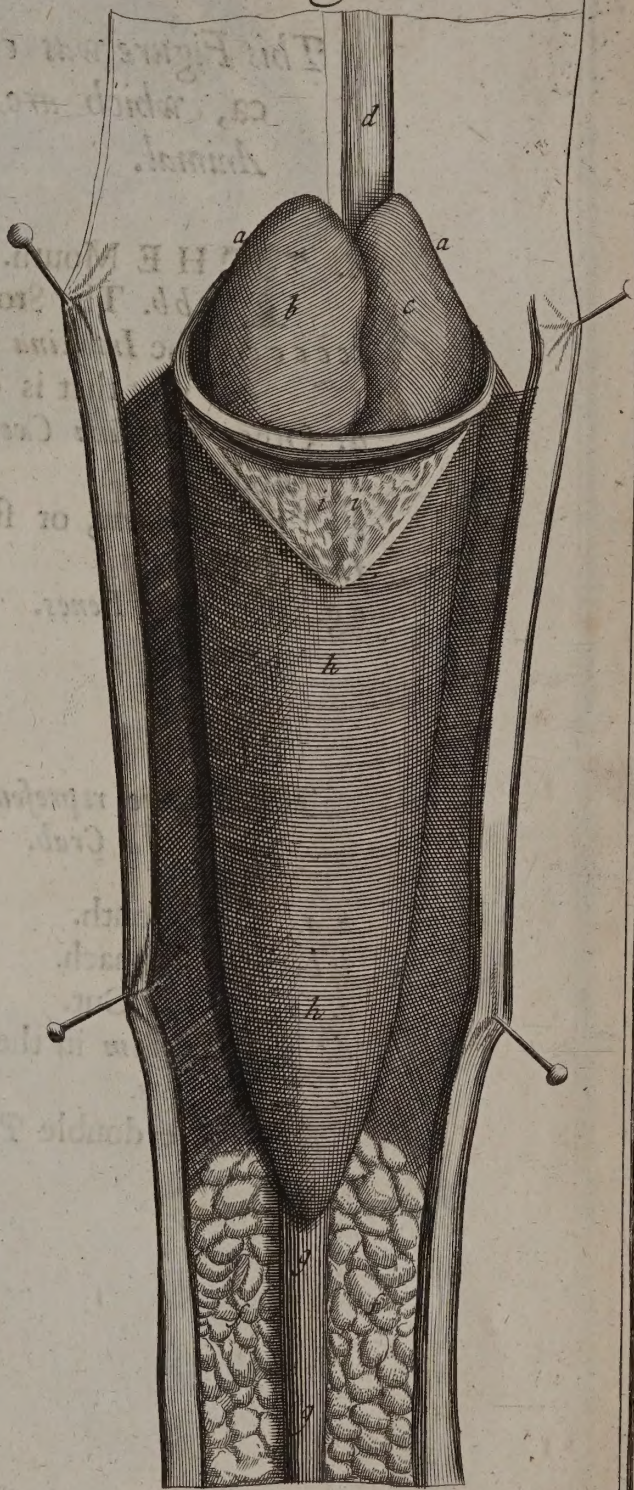
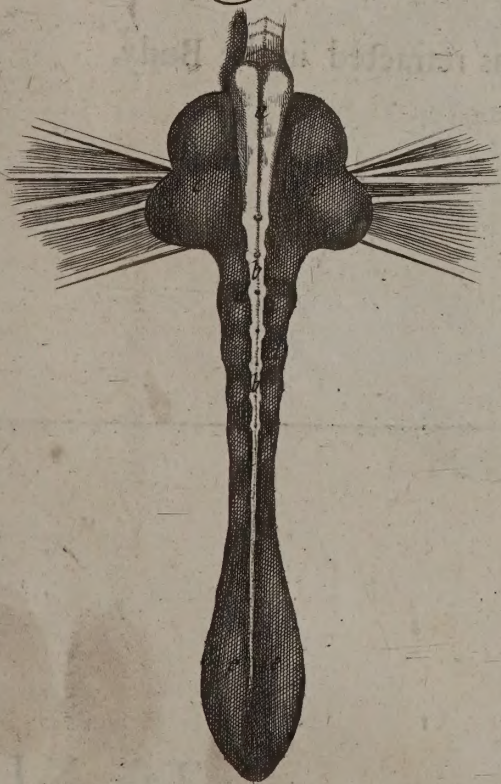


Fig. 3.



Fig. 4.



Tab. XXXIX. Fig. 1. *A Crab opened,*
By Doctor Edward Tyson.

This Figure was chiefly designed to represent the Intestina Cæca, which are more numerous in a Crab then in any other Animal.

- A. **T** H E Mouth.
bb. The Stomach.
cccccc. The Intestina Cæca, filled with a Chymous substance, and is that part that is dressed in eating a Crab.
d. Other Intestina Cæca that lye upon the straight Gut that lies in the Body.
e e. The Rectum, or straight Gut that lies in the Tail.
f. The Finns.
gg. The two Penes.

Fig. 2. *Of a Crab opened.*

This Figure represents the Mouth, the Stomach, the Intestine, and double Penis of a Crab.

- a a. The Mouth.
b b. The Stomach.
c. The First Gut.
d. The Rectum in the Tail.
e. The Finns.
f f f f. The double Penis *in situ naturali*, as retracted in the Body.

Fig. 3.

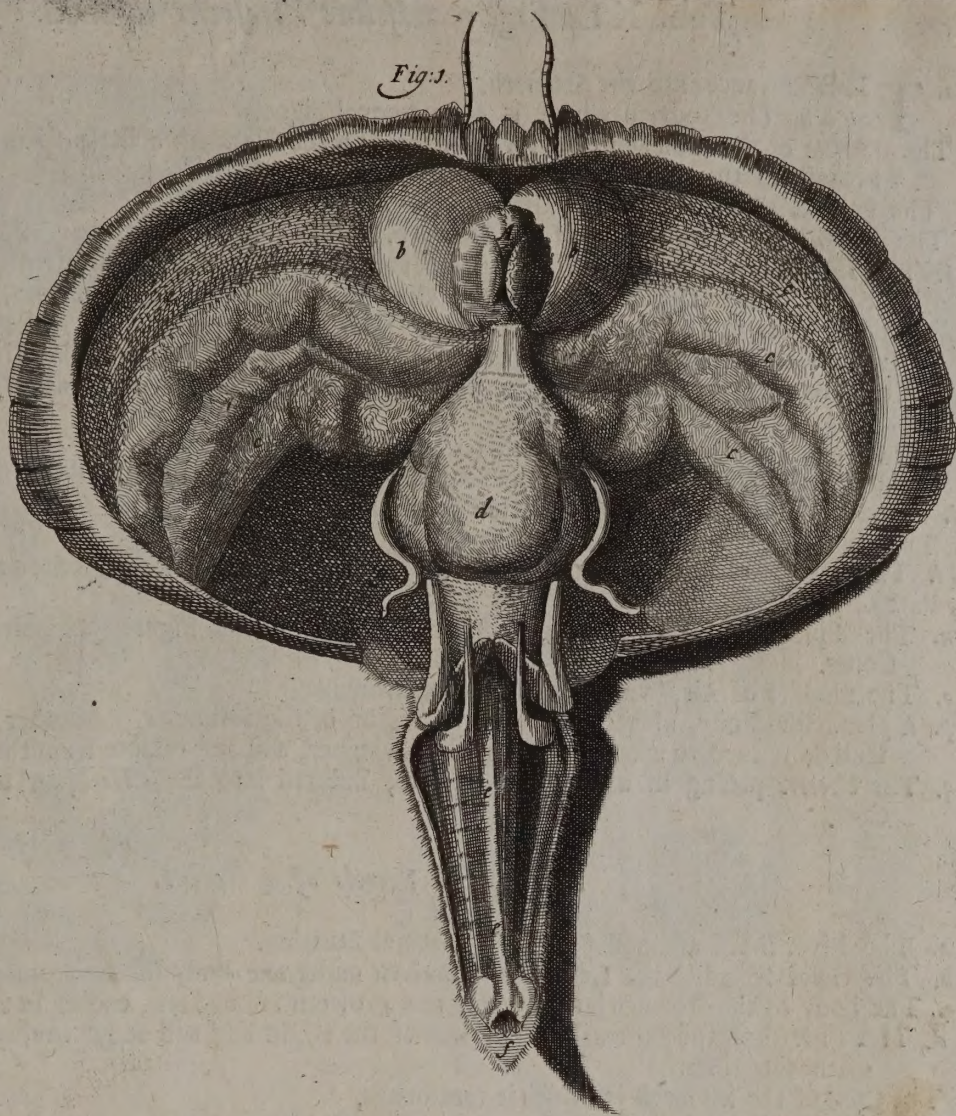
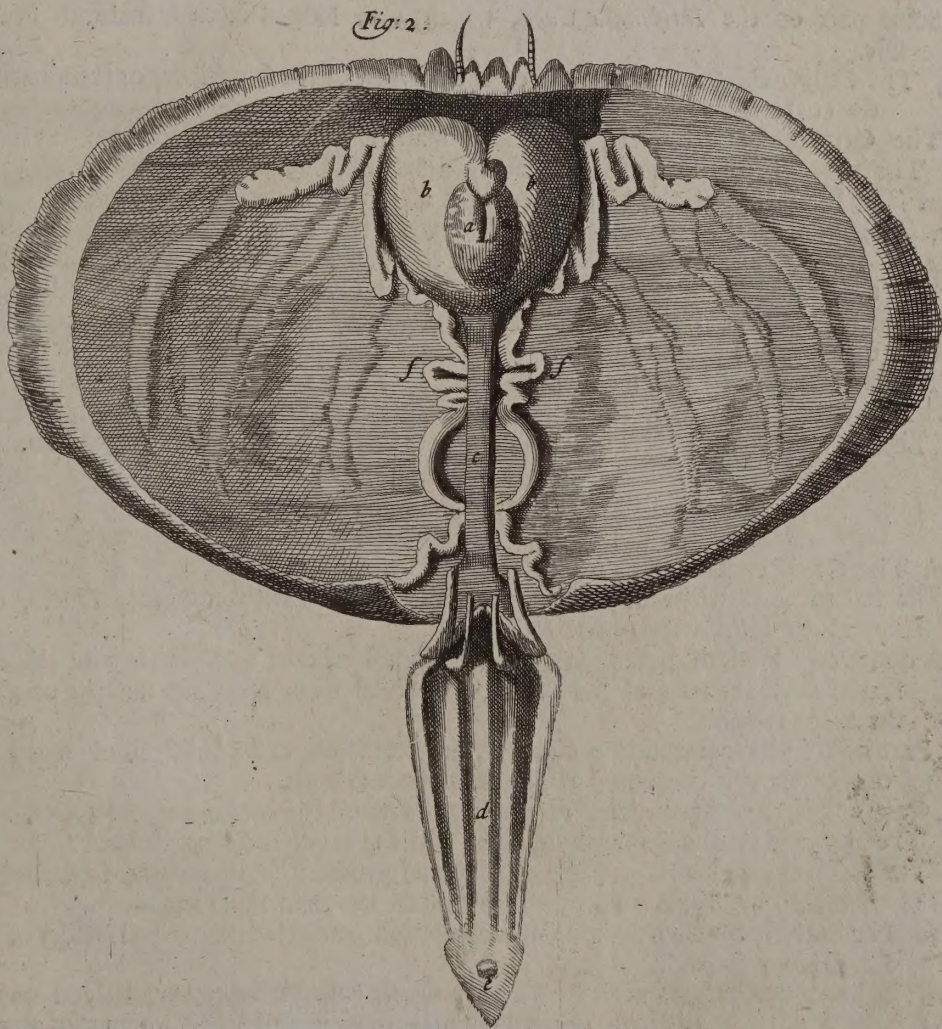


Fig. 2.



Tab. XL. Fig. 1. *Asellus Virescens* opened.

- a a.* THE entrance into the Stomach.
b b b. The Stomach which is of one equal bigness.
c. The bottom of the Stomach out of which the Aliment ascendeth a little space, and passeth into a Process to the Pylorus.
d. The Process of the Stomach ending in the Pylorus.
e. The Pylorus, or termination of the Stomach.
f f. The *Intestinula Caca*, which are very numerous, resemble a bunch, made of very short Bodies, beginning near the Pylorus, and encircling the Origen of the Intestines, where the first Circumvolution is Semi-circular, and passeth under the Intestines, and goeth down somewhat wheeling to the bottom of the Belly, and passeth at last under the other Intestines, and maketh first a Semi-circle, and afterward diverse other Mæanders, which in some manner resemble Spires.
g. The Mæander of the first Gut, which is Semi-circular.
h h. The spiral windings of the Intestines lodged in the lower part of the Belly.
i i. The Second Gyre, or Circumvolution of the Intestines seated above.
k. The *Anus*, or termination of the Guts.
l l l. The largest Lobe of the Liver turned out of situation, to discover the Stomach.
m. Part of the Liver *in situ*.
n n. The Spleen of a dark Red colour, and of an oblong Figure, beginning and ending in Cones.
o o. The Bladder of Air, vulgarly called the Swimmer.
p p. A glandulous Body, affixed to the upper region of the Swimmer. Another Gland not represented, fastned to another part of the Swimmer, not far remote from the other.
q q. The *Ureters* passing in a wheeling posture, inserted into the *Cloaca*, or termination of the Guts.

Fig. 2. The Bowels of a *Rochet*.

- a a.* The Liver lifted up, and put out its natural situation.
b b. The Gullet seated in the Left side, wheeleth under the body of the Stomach.
c c. The body of the Stomach large above, and groweth less and less, ending in an obtuse Cone.
d d. The Process of the Stomach, arising out of the Right side, and at last conjoynd to the Origen of the Intestines.
e. The Cone of the Stomach in which it terminates.
f f. The Blood-vessels of the Stomach.
g. Some part of the Bladder of Gall appearing near the Right side of the Stomach.
h. Some part of the *Intestinula Caca*, which were lodged in their natural situation on the Left side.
k k. The *Intestinula Caca* arising out of the Origen of the Intestines, or termination of the Stomach, do cover them.
i. The Origen of the Bowels, where they make the first Circumvolution.
l l. The progress of the Intestines, making a Second Circumvolution below.
m m. The Filaments of the Nerves wrought after the manner of Network.
n n. The Intestine that runneth obliquely toward the Left side, and terminates at the Vent.
o o o. The Ovary ascending on both sides of the Vesicles of Air, vulgarly called Swimmers.
p. The Ducts arising out of the termination of the Ovaries, through which the little Eggs are transmitted into the *Cloaca*, or end of the Intestines, in the time of Spawning.
q. Part of the Kidney seated above.
r. The terminations of the Kidneys near the Vent, where they both unite.
s s. The Vesicle of Air, or the Swimmer in the Right side, which is much the larger.
t t. The Swimmer, or Vesicle of Air in the Left side, which is less in dimensions.

Fig. 3. The Bowels of a *Tench*.

- A A.* The Cones encompassing the Palate.
a. The Palate beset with many minute Glands, attended with excretory Ducts, discharging a thin Liquor into the Cavity of the Mouth.
b. A Bone, of a kind of pyramidal Figure, biggest above, and smallest in the termination, and is seated near the root of the Palate, conceived to be after the manner of a Millstone to grind the Aliment upon.
c c. Part of the Liver seated in a circle of the Intestines, and consisteth of many *Globuli* and every one of them is composed of diverse minute Glands.
d d. Part of the Liver descending in the Right side on the confines of the Liver.
e e. The entrance of the Stomach opened, and the inside is full of folds.
f f. The Stomach beginning in large dimensions, groweth smaller towards the end.
g. The termination of the Stomach, which is much less then the Origen.
h h h. The Intestines which make a Circumvolution, encirclet diverse Globules of the Liver.
i. The *Intestinum rectum*.
k k. The lower and larger Vesicle of Air, commonly called a Swimmer, lodged under the Guts, and is of a pyramidal Figure, beginning in large dimensions, and ending in an obtuse Cone.

Fig. 1.

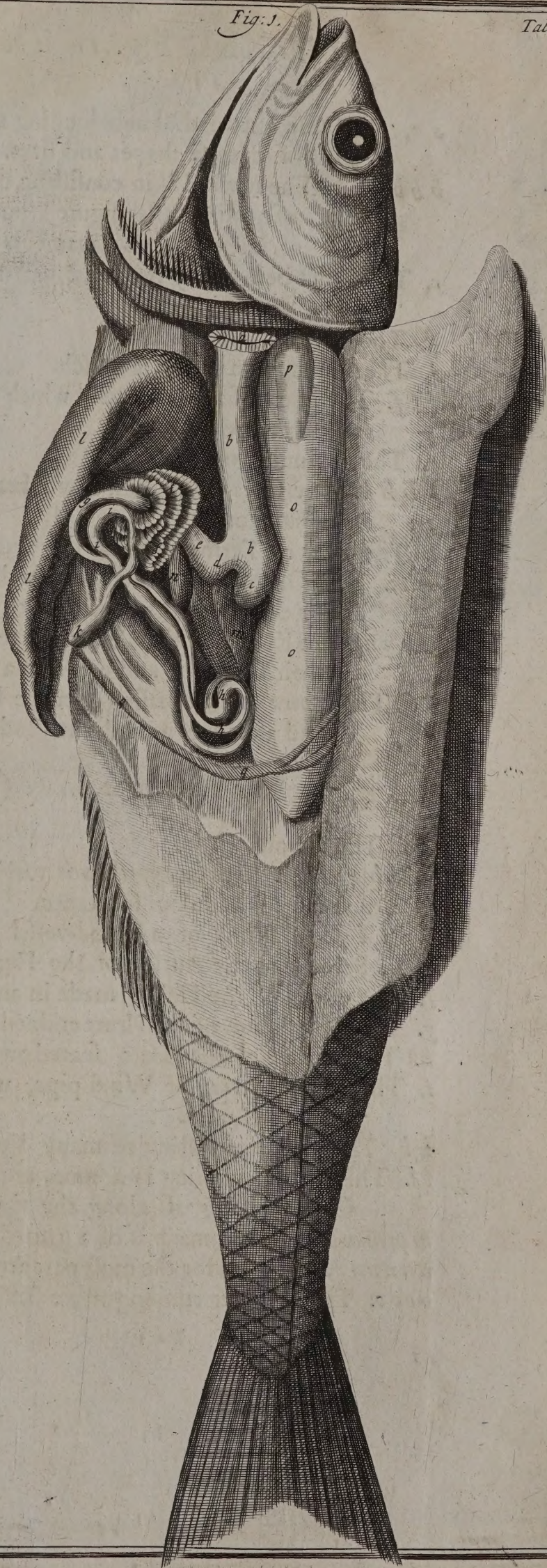


Fig. 2.

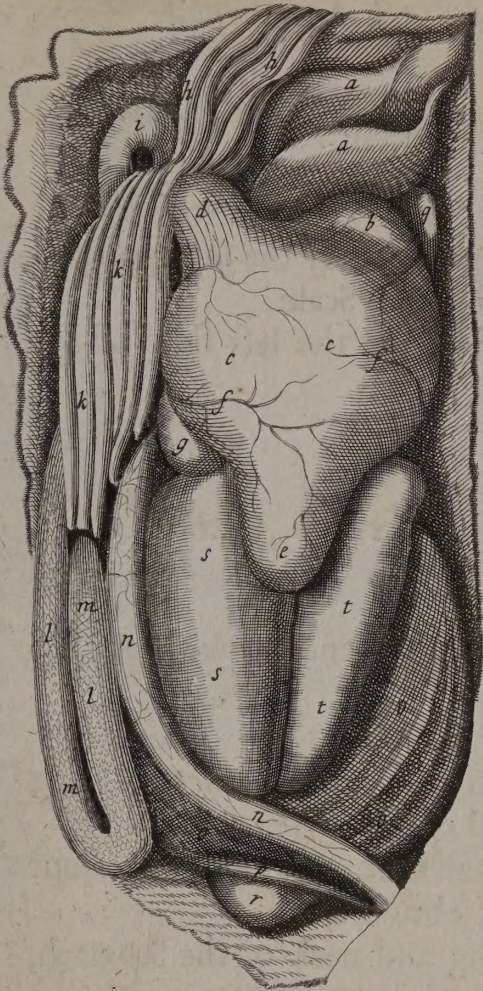
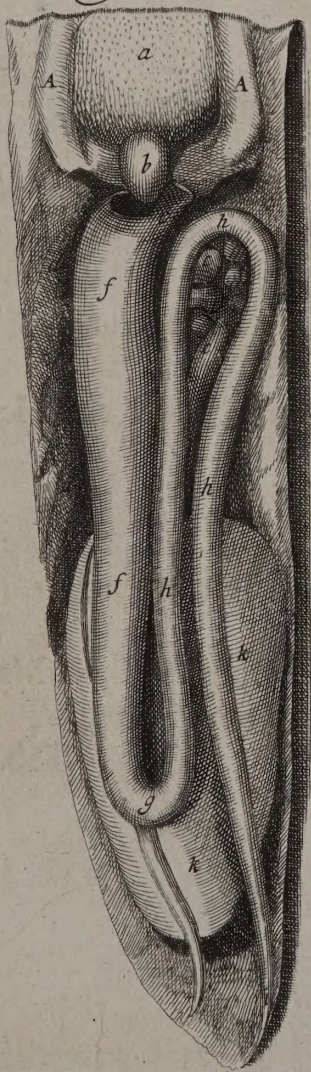


Fig. 3.



Tab. XLI. Fig. 1. *The Body of a Viper opened.*

- a a.* **T**He outward Skin belonging to the Neck consisting of many Scales of diverse shapes and sizes.
- b b b b b.* The inward Skin consisting of many Scales (endued with a kind of quadrangular figure) mutually connected by the interposition of Membranous Ligaments encircling each Scale.
- c.* The Gullet being very long and narrow, passing on the left side of the *Aspera Arteria*.
- d.* The origen of the Stomach.
- e.* The termination of the Stomach.
- fff.* The body of the Stomach, which seems to be double, as parted by an oblong narrow Neck.
- g.* The beginning of the Guts.
- h h h h.* The Guts having but few Mæanders, and are endued with various dimensions.
- l.* The *Anus* or Termination of the Guts.
- m m.* Two Glandulous substances which seem to be a double *Pancreas* lying on each side of the great Gut, and tied to the Kidneys.
- n n n n.* The Kidneys lodged on each side of a small Gut, and are larger about their Origenes, and end into a kind of obtuse Cones.
- o o.* The *Aspera Arteria* passing over the beginning and neck of the Stomach, and after creeps under its Body.

Fig. 2. *The Body of a Snake (falsly called a Viper) opened.*

- a a.* The inward *Cutis*.
- b b b b b b b b.* The outward *Cutis* variegated with many colours.
- c c c c.* A fatty glandulous substance.
- d d d d d.* A Trunk of a Blood-vessel (as I conceive) passing near the † *E. Spine* † to the Auricle of the Heart.
- f.* The origen of the Heart, made in an obtuse Cone.
- g.* The termination of the Heart endued with a more acute Cone.
- h.* The Auricle of the Heart, seated on the right side.
- i.* The *Aspera Arteria*, or Wind-pipe, which creepeth under the Heart towards the Lungs.
- k k.* The Lungs consisting of many Vesicles of Air.
- ll.* The Liver beginning in a more acute, and ending into a more obtuse Cone, passing all along the right side of the Stomach.
- m m m m m.* The Stomach is of a great length.
- n n n n n n.* The Guts for the most part are framed in numerous short Mæanders.
- o o o o.* The last Gut running more straight without any Gyres.

Tab. XLII.

Fig. 1.

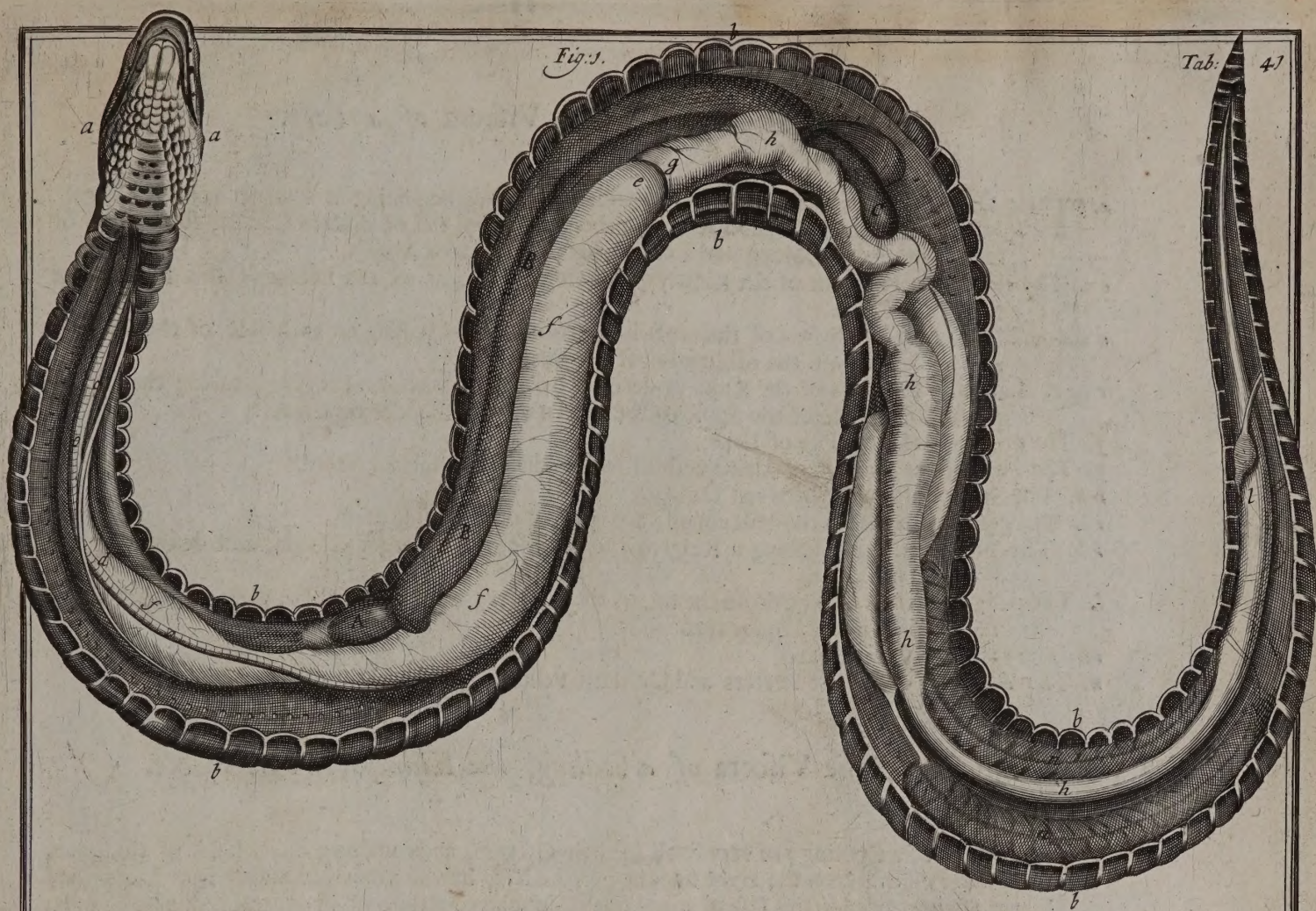
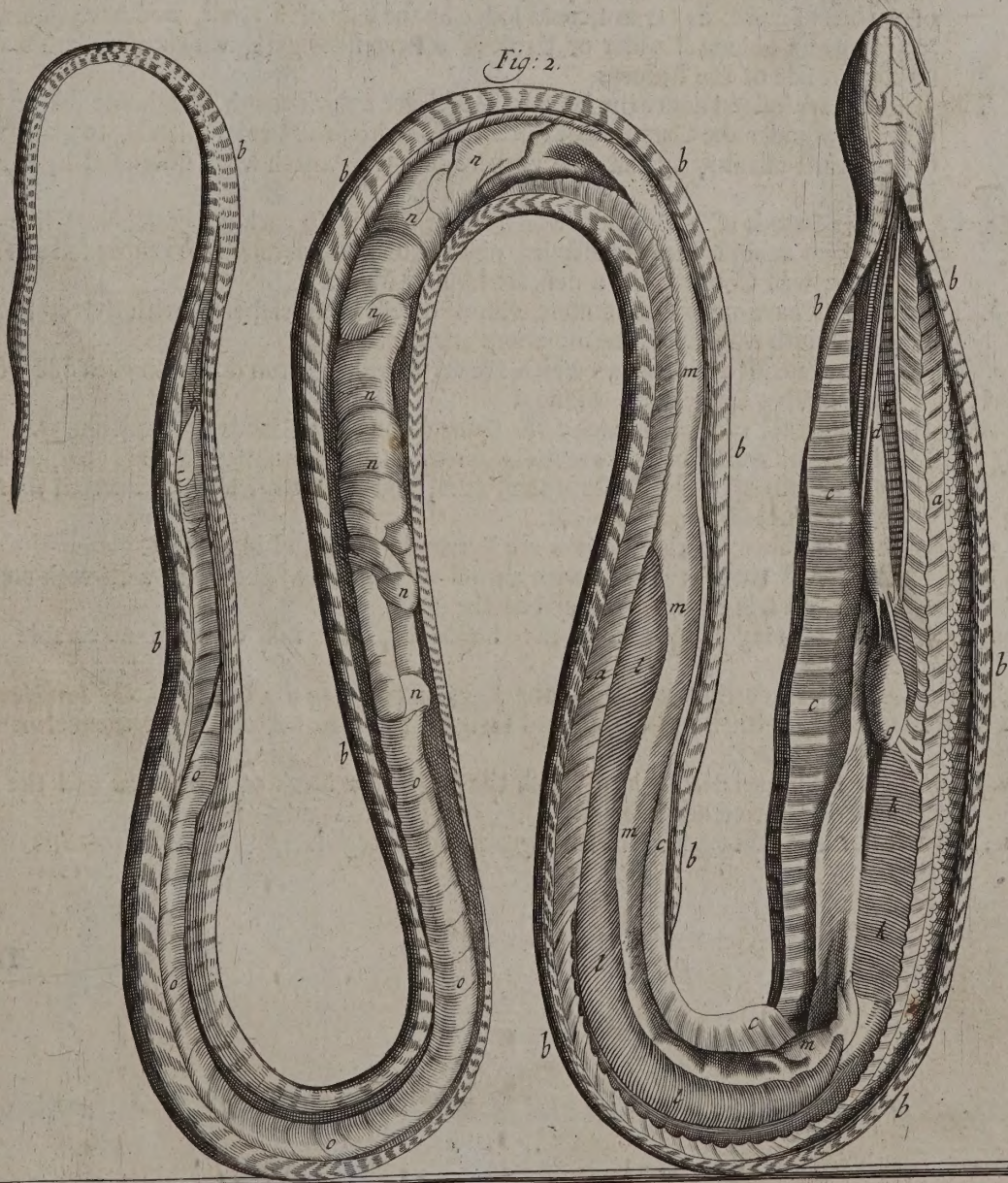


Fig. 2.



Tab. LXII. Fig. 1. *The Viscera of a Carp.*

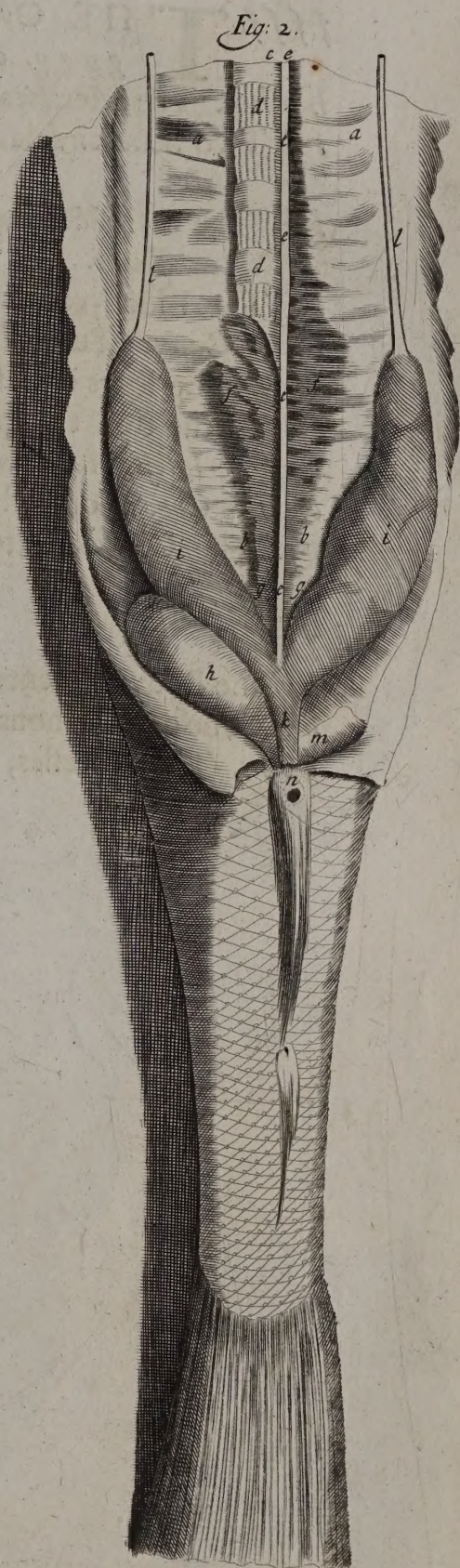
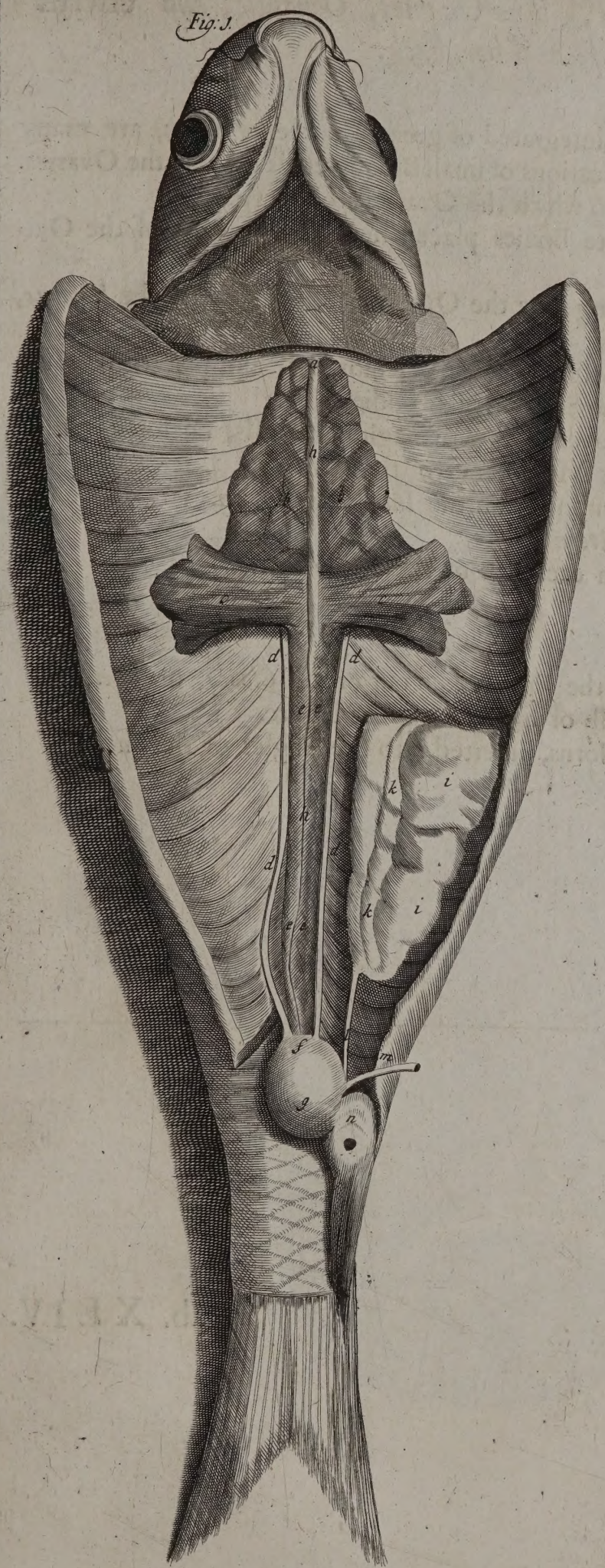
- a.* The Origins of the Kidneys of a Carp which are small, beginning as it were in obtuse Cones.
b b. The Progress of the Kidneys or body of them full of diverse Glands, some oval or round, others of Oblong and a conick figure of various Angles.
c c. The Cruciform Processes of the Kidneys, as going transverse to the insides of this Fish, in the form of a Cross.
d d d d. The Ureters coming out of the cross-like Processes, and passing on each side of the Kidneys are implanted into the origination of the Bladder.
e e e e. The small Processes of the Kidneys derived from the Cruciform Processes, taking their progress on each side of the Spine to the origin of the Bladder of Urine.
f. The origin of the Bladder of Urine.
g. The body of the Bladder of Urine endued with a kind of Orbicular figure.
h h. The Spine descending between the Kidneys.
i i. The greater Glands of the Milt cut off, and passing on each side of it.
k k. The smaller Glands making a Ridg in the middle of the larger Glands, and descending the whole length of it.
l. The deferent Vessels (going down the side of the Bladder) is inserted into the Vent, and dischargeth the Seminal milky Liquor through it.
m. The Deferent Vessels cut off.
n. The Vent into which the Ureters and Deferent Vessels disburden their various Liquors.

Fig. 2. *Of the Viscera of a Codling, the Kidneys, Ovaries, &c.*

The Kidneys of a Codling are very small in their Origins, and run down on each side of the Spine, and are much less on the right side then on the left, in which they are chiefly seated, and they are Compounded in this Fish of many small Globules consisting of innumerable minute Glands, of a round Figure, as far as I could judge by the help of a Glass, and have short Ureters inserted into an oblong Bladder of Urine of a Pear-like figure, which ascendeth under the Guts on the left side of the Kidneys.

The Kidneys are lodged under the Sounds, which are a thick tough Membrane full of Glands, and sits hollow under the Guts at some distance from the small tender Glands, to guard them against the outward assaults, against the pressure of the Stomach when distended by a Fish received into it.

- a a.* Part of the Sounds of a Codling, which being whole, do enclose the Kidneys like a Sack, and secure them against outward assaults, and are of a Membranous substance full of small Glands, and being well Cooked, are a delicate Dish of Meat.
b b. These Sounds have many small oblong white Processes (interspersed with the red Processes of the Kidneys) into which their terminations are implanted.
c c. The Originations of the Kidneys which are very small, and run down on each side of the Spine.
d d. The Spine passing between the Kidneys.
e e e e. A Blood-vessel running all along the Spine among the Glands of the Kidneys.
f f f f. The bodies of the Kidneys are much larger then their beginning, and are compounded of many small Glands of different shapes and sizes, and have their Ureters inserted into the Bladder of Urine not far from its Neck.
g g. Near their termination the Kidneys are Pyramidal, and end in acute Cones.
h h. The Bladder of Urine is endued with a kind of Pear-like figure, and ascendeth under the Guts on the left side of the lower end of the Spine.
i i. The Ovaries being lodged near the Intestines, are full of an innumerable company of small Eggs.
k. The *Vagina* or Duct through which the Eggs do pass into the cavity of the *Intestinum Rectum*.
l. The Blood-vessels which are divaricated through the Ovaries, and sport themselves in numerous minute Branches.
m. Part of the *Intestinum Rectum* into which the *Vagina* or Neck of the *Uterus* and the Duct of the Bladder of Urine are inserted.
n. The Vent or *Anus* through which the Eggs are discharged.



Tab. XLIII. Fig. 1. *The Ovaries, Oviducts, and Uterus
of a Thornback.*

- ffff.* **T**HE Ovaries integrated of greater and lesser Eggs, are many
gggg. divarications of small Blood-vessels, shading the Ovaries.
bbbb. The Membranes to which the Ovaries are affixed.
ii. Two Semi-circular white Bodies placed near the Origins of the Ovi-
ducts.
kk. The Oviducts beginning near the Ovaries, and ending in the *Uterus*,
or *Cloaca*.
ll. The Blood-vessels tied together by Membranes, and placed near the
Convex Surface of the Semi-circular Bodies.
mm. The Eggs incruusted over with Cartilagiuous shells, enclosed within
the thin transparent Membranes of the Oviducts.
n. The *Intestinum Cæcum* confining on the *Intestinum rectum*.
o. The *Cloaca*, or rather *Uterus*.
pp. The Glands seated on each side of the *Cloaca* or *Uterus*.

Fig. 2.

- a.* The Body or Center of the Egg, taken out of the *Cloaca*, or *Uterus*.
bb. The cartilaginous Shell of a quadrangular Figure.
cccc. The Processes, or Horns, inserted into the Angles of the Shell.

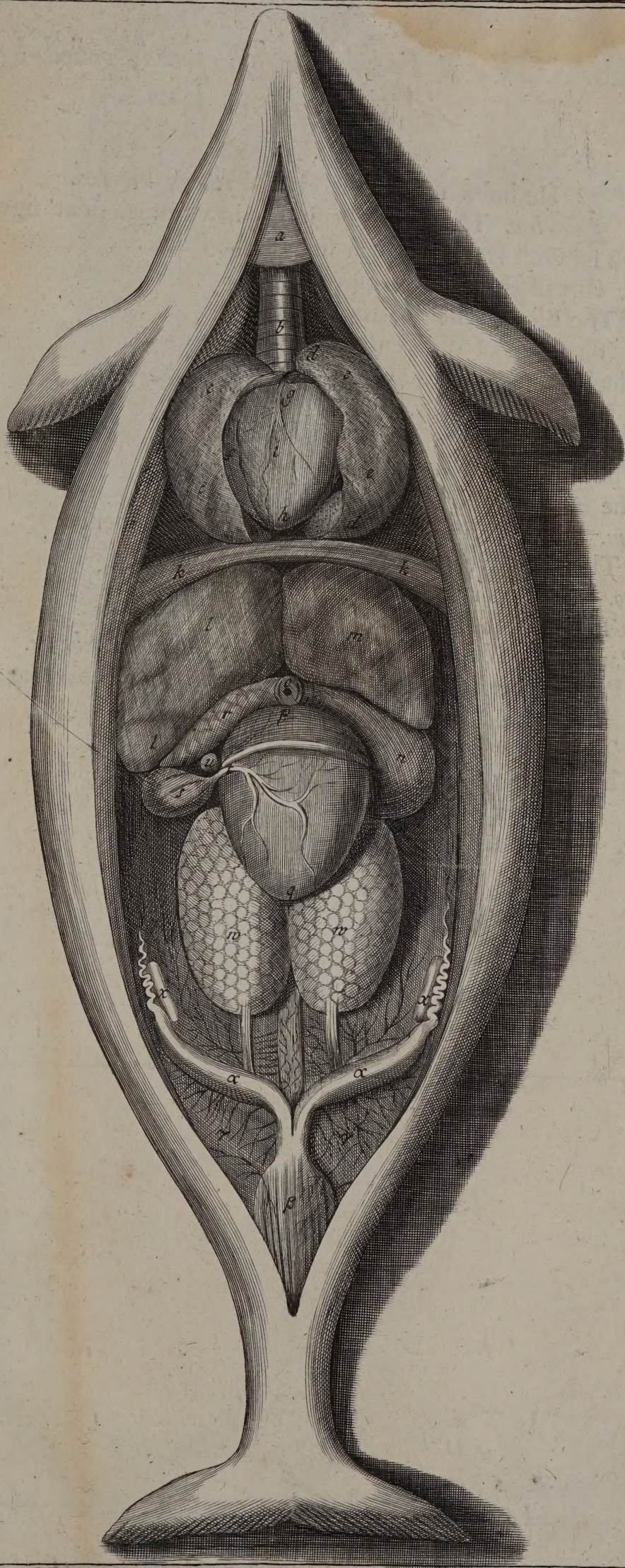
Tab. XLIV.



Tab. XLIV. *A Female Porpefs opened.*

- a.* **P** Art of the Buckler Cartilage belonging to the *Larynx*.
b. The Wind-pipe, consisting of annular Cartilages, interspersed with Membranes.
c c. The Lobe of the Lungs, encompassing the Right side of the Heart.
d d. The Lobe of the Lungs enclosing the Left side of the Heart.
e e. The Surface of the soft Lobes, adorned with the terminations of vessels, resembling Network.
f. Part of the *Pericardium*, covering part of the Right side of the Heart.
g. The Base of the Heart.
h. The Cone of the Heart.
i. The Blood-vessels passing down on one side from the Base toward the Cone.
k k. The Diaphragme having its Concave- Surface toward the Stomach, and Convex toward the Heart.
l l. The Right Lobe of the Liver greater then the other.
m. The Left Lobe of the Liver covering part of the lesser Stomach.
n. The lesser Stomach seated under the greater, in the Left side.
o. Some part of the Origen of the Guts (cut off) which adjoined to the lesser Stomach.
p. The upper part of the Stomach.
q. The bottom of the Stomach ending into an obtuse Cone.
r. The *Pancreas* made up of numerous Glands.
s. The Spleen hued with a livid colour, adorned with a Pear-like Figure, fastened to the upper Surface of the Stomach, by Ligaments.
t. The Ligaments tying the Spleen to the Stomach.
u. One small orbicular Body adjacent to the beginning of the Spleen.
w w. The Kidneys (endued with an Oval Figure) made up of many Glands.
x x. The Testicles, or Ovaries, endued with an obtuse Conick Figure.
y y. The Oviducts passing in short Mæanders, and terminating into the beginning of the *Cornua*.
α α. The *Cornua* of the *Uterus*, being narrow in their Origen, and afterward are more enlarged.
β. The Body of the *Uterus*.
γ γ. The Blood-vessels running to the *Cornua* and Ovaries.

Tab. XLV.



Tab. XLV. *A Female Dogfish opened, called by the Latines Galeus Lævis.*

- a a.* **T**He holes relating to the Olfactory Nerves.
b b. The Palate beginning in a Semicircular figure.
c c c. The Gills seated on each side of the Palate.
d d d. Part of the Stomach turned up.
e e e. The Blood-vessels of the Stomach.
f f f. The Eggs of different magnitudes.
g. The beginning of the Oviducts.
h h. The body of the Oviducts.
i. The termination of the Oviducts.
k. The *Intestinum Cæcum*.
l. The *Intestinum Rectum*.
m m m. The *Uterus* lodged in the right side not opened.
n n. The Blood-vessels of the *Uterus* not opened.
o o o o. The upper rank composed of four *Embryos*.
p p. The Tails of the *Embryos* turned up.
q. Part of the *Chorion* covering somewhat of the *Embryos*.
r r. Part of the *Uterus* belonging to the left side, covering the lower rank of Fish.
s s. The *Sinus* seated on each side of the Vent.
t. The Vent.
u u. The upper *Sinus* seated below the Gills.
w w. The Vent.

Tab. XLVI.



Tab. XLVI. Fig. 1. *Of a Silkworm.*

- a a.* The two Processes about the Mouth, by which being contracted, it taketh Aliment into its Mouth.
b b b b b b. The Incisures or Rings of the Silkworm wherein it resembleth a Caterpillar.
c c. The Legs affixed to the Wings, seated about the Belly.
d. Part of the *Anus*, coming out of the Body.

Fig. 2.

- a a.* The open and rough Contexture of the outward Coat relating to a Silkworm.
b b. The large Network and large empty Spaces of the outward Coat.
c c. The Frame of the middle Coat, more loose then the third.
d d. The *Aræ* of the middle Coat are greater then the outward.

Fig. 3.

- a a.* The third Coat made up of Filaments finely spun.
b b. The *Aræ* of this Coat more large then the third Coat.

Fig. 4. *Of the upper Region of a Silkworm.*

The Skull being Cartilaginous consisteth of five Processes, two small ones near the Mouth endued with a round oval figure, and two great oblong Ovals, besetting each side of the middle Oval much broader then the rest, beginning in a kind of Semicircular figure and ending into an obtuse Cone, which hath many slender crooked Processes adjoyning to its Extremity.

- a a.* The roundish Oval Processes adjoyning to the Mouth.
b b. The greater and more oblong Oval Processes besetting each side of the middle Process.
c. The middle Process being broader, and ending into an obtuse Cone.
d d. The crooked narrow Processes adjoyning to the Cone of the middle Process.
e e e e e e. The Silkworm resembling a Maggot, is made up divers Incisures or Rings which grow less in Circumference toward the Tail.
f. The joynted Case is narrow in its Origen, sitting close to the Head like a Coife.
g g. The obtuse Cone or Termination of the Annular Case.
h. The brown Shade running along the middle of the Back.

Fig. 5. *Of the lower Region of the Silkworm resembling a Maggot.*

- a a.* The Eyes of the Maggot.
b b. The Mouth of the Maggot.
c c. The Wings lying close to the Breast, being bound down by the Case.
d. The Fissure of the *Anus* dividing the last Incisure ending in a Cone.
e e e e. The black spots seated on the sides of this Animal, being the Origens of the *Tracheæ*, or Air-Vessels.

Fig. 6. *Of the upper Region of a Silkworm resembling a Moth.*

- a a.* The Horns springing out of the Head and running cross-ways.
b b. The Head or Skull consisting of many Processes covered with Down.
c c. The Comb-like Fibers sprouting out of an oblong crooked Trunk.
d d. The Semicircular Incisures near the Head.
e e. The Circular Incisures seated in the Body, clothed with Down or fine Feathers.
f f. The upper Wings being larger then the under †, are endued with a Trunk, out of which do arise many smaller Branches of Fibres.
h h. The Thighs attended with Legs, are affixed to the lower Region of the Incisures of the Breast.

Fig. 7. *Of the lower Region of a Silkworm.*

- a a.* The Horns are affixed to the sides of the Apex of the Head, and have many Comb-like Fibers arising out of a large Horn.
b b. The Eyes being black and round, are distinguished by the interposition of a small Prominence dressed with fine Down.
c c. The Down between the Eyes and upper Thighs ending in a point, doth somewhat resemble a Beard.
d d d d d d. The Thighs, Legs, Feet, and Clawes, consisting of three Joynts, and beset with fine Feathers, and have their Thighs almost conjoynd upon the Incisures of the Belly.
e e. The double Wings fastned to the side of the Head, whose lower Region have concave Surfaces.
f f. The Ovary through which the covered Eggs appear.
g g. The Eggs appearing more plain (as their Ovary is taken off) endued with a flattish Oval Figure.
h. The *Anus*.

Fig. 1.



Fig. 2.



Fig. 4.

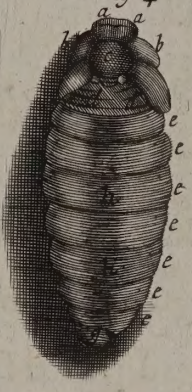


Fig. 5.

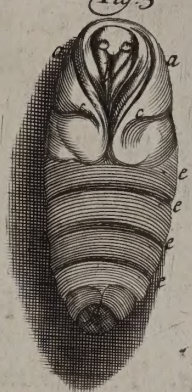


Fig. 3.

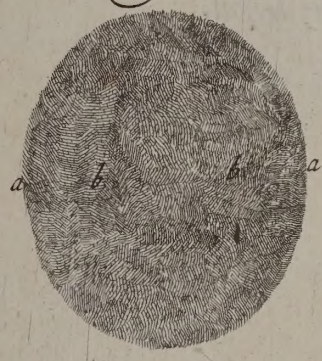


Fig. 6.

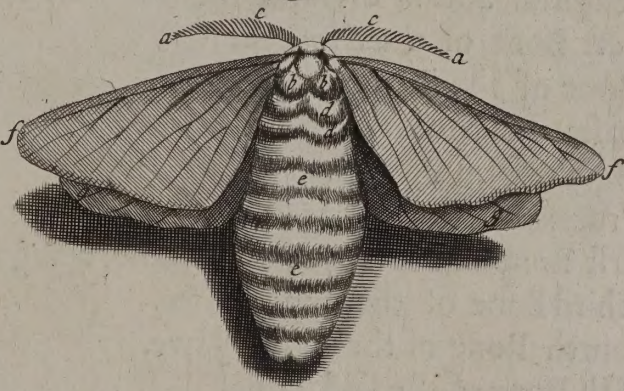


Fig. 7.



Tab. XLVII. Fig. 1. *The Explanation of some part of a Humane Brain.*

- a a a a.* **T**HE two Hemisphæres of the Brain, parted by the Falciforme Process.
- b b.* The *Dura Menynx* covering the Right Hemisphære.
- c c c.* The Blood-vessels branched through the *Dura mater*.
- d d d d.* The *Vasa serosa*, being a kind of Lymphatick Vessels, appearing in the Coats of the Brain.
- e e e.* The *Anfractus*, or Gyres of the Brain, resembling Intestines.
- f f f f.* The *Pia Mater* divested of the *Dura Menynx*.
- g g.* The Blood-vessels of the *Pia Mater*.
- h.* The Origen of the Falciform Process, near the *Os spongiosum*.
- i.* The termination of the Falciform Process in the *Occiput*.

Fig. 2. *Relating to the upper region of the Skull.*

- a a a.* The Bone of the Forehead parted from the Bones of the *Synciput*, by the Coronal Suture.
- b b.* The Coronal Suture passing through the Skull transversly.
- c.* A hole of the Forehead made for the egress of the Fifth pair of Nerves.
- d.* The Right Bone of the *Synciput*.
- e e.* The Sagittal Suture dividing the Bones of the *Synciput*.
- f.* The Left Bone of the *Synciput*.
- g.* The Bone of the Temples.
- h.* The bastard Suture.
- i.* The Mammiform Process.
- k.* The Process of the *Os Jugale*.
- l.* The first Bone of the upper Mandible being somewhat obscured.
- m.* The third Bone of the upper Jawe.
- n.* The fourth Bone of the upper Jawe.
- o.* The fifth Bone of the said Jawe.
- p.* The lower Jawe.
- q.* The acute Process of the lower Jawe.
- r.* The blunt Process of the said Mandible.
- s s.* Part of the *Lamdoidal Suture*.

Fig. 3. *Relating to the lower region of the Skull.*

- a a.* The Process of the *Occiput* to which the first verteber of the Neck is conjoyned.
- b b.* Part of the Bone of the Temples.
- c c.* The Mammiform Processes.
- d d.* The Styliform Processes.
- e e.* The Process called *Jugalis*.
- f f.* The outward Surface of the wedg-like Process.
- g g g g.* The wing-like Process, called by the *Latines*, *Processus aliformis*.
- h h.* The Bridge of the Nostrils.
- i.* The sixth Bone of the upper Mandible.
- k k.* Part of the fourth Bone of the lower Mandible.
- m.* The four Teeth, called *Incisores*.
- n n.* The two Dog-like Teeth, called *Canini*.
- o o.* The rest of the Teeth, called Grinders.

Fig. 1.

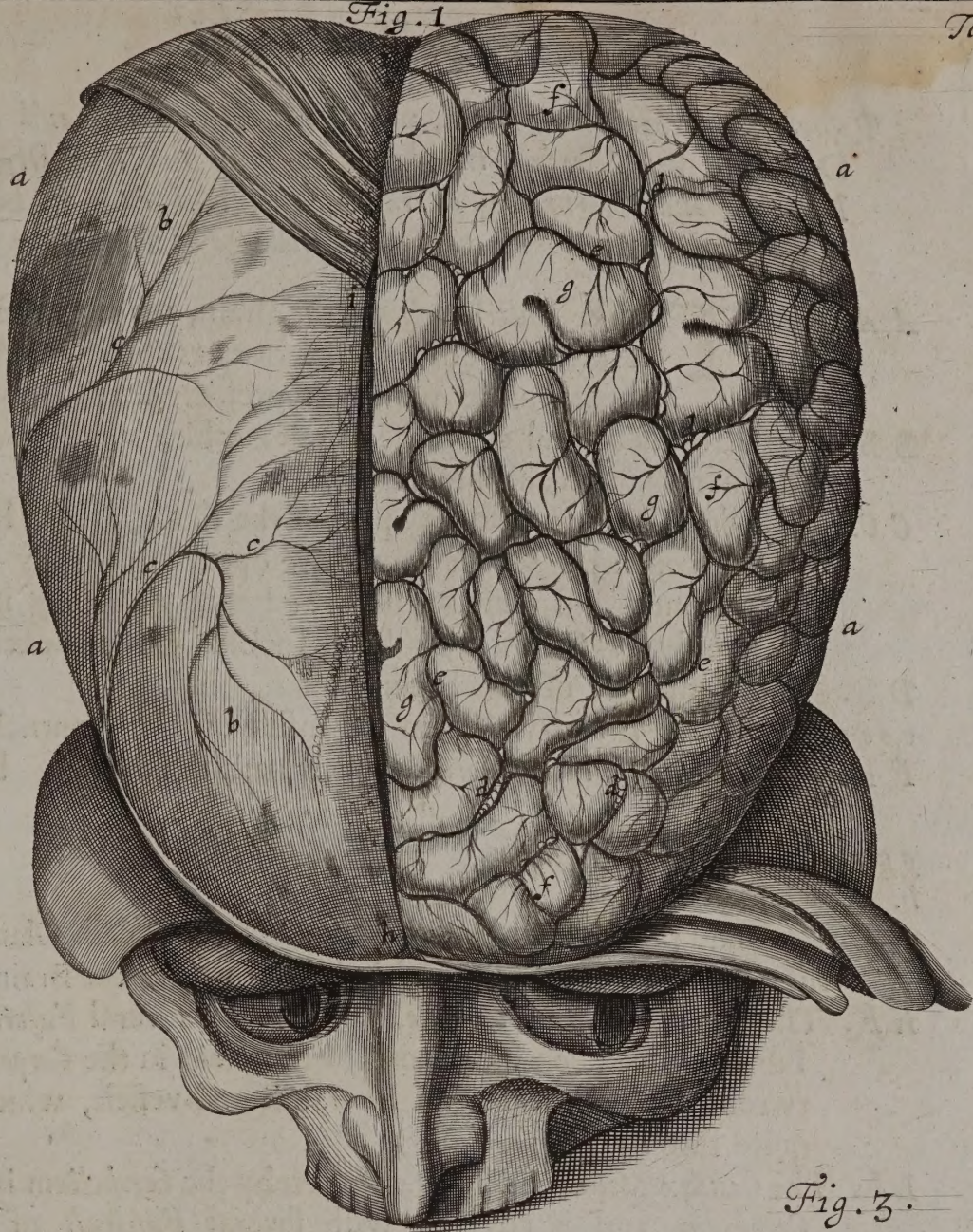


Fig. 2.

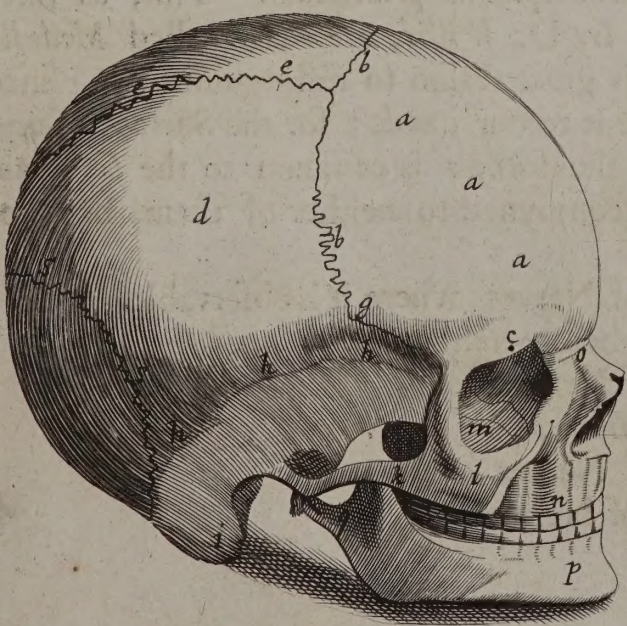
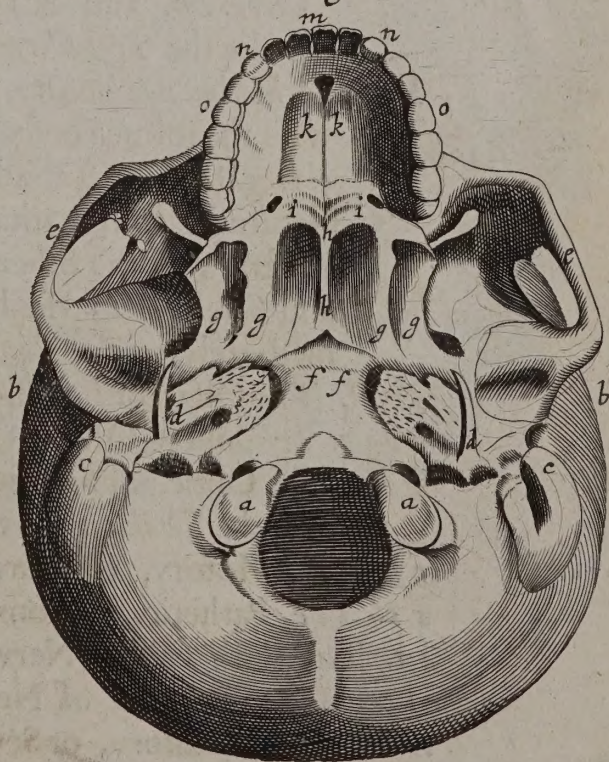


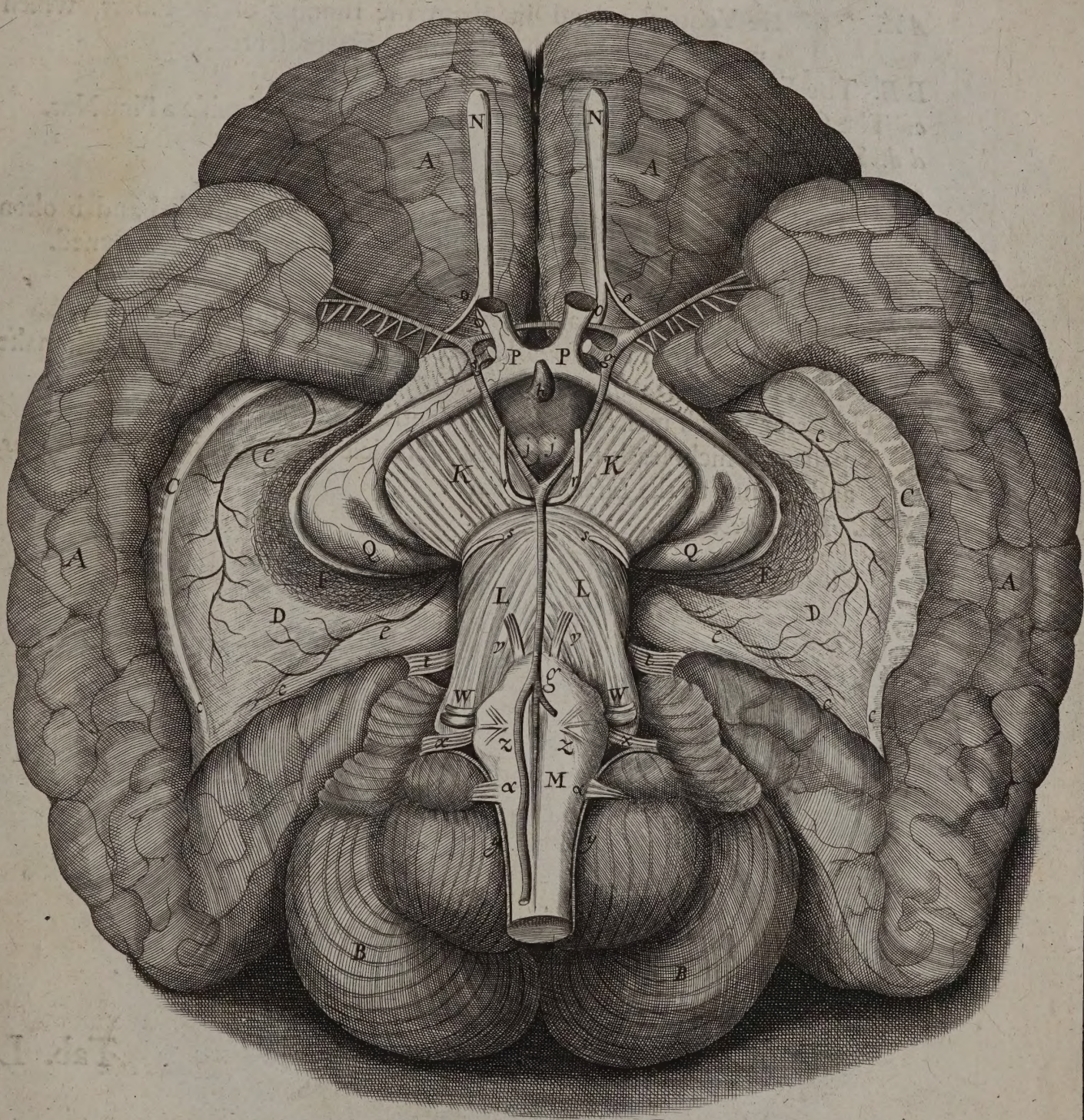
Fig. 3.



Tab. XLVIII.

Represents an Humane Brain, with its Basis upward, and divested of the Dura and Pia Mater; the better to shew the true Origination of the Nerves, and the running of the Fibres, laid open by Learned Dr. Edward Tyson, in the Theater of the Colledge of Physicians in London.

- A A A A.** **T**HE four Lobes of the Brain, wherein the division of the Anterior from the Posterior, as also the *Anfractus* in each, are more plainly represented
- B B.** The *Cerebellum*, and here the Circles which compose it, are plainer and truer than in any Figure yet.
- C C.** The edges of the Medullary part of the Brain, which lines the insides of the Ventricles which were here opened, only by separating the Membranes, and Blood-vessels, and gently dilating it with my Fingers, only at (*c c c c.*) a small Incision was made with the knife.
- D D.** The Ventricles of the Brain.
- e e e e.* Four large Blood-vessels on the inside of the Ventricles.
- F F.** The *Tunica*, or *Plexus Coroides* in its natural situation, but a little expanded.
- g g g.* The Carotide Arteries.
- h.* The *Infundibulum*.
- i i.* Two round protuberant Bodies which Dr. *Willis* calls Glands, but are of the same substance with the Medullary part of the Brain.
- K K.** The *Crua Medullæ oblongatæ*, composed of several *Fasciculi* of nervous Fibres, which continued, makes the *Stria* in the *Corpora Striata*; between these *Fasciculi*, run several Blood-vessels, which pierce them quite through.
- L L.** The *Caudex Medullæ oblongatæ*, whereby the *Cerebellum* is joyned to the *Cerebrum*, and is covered with several *Fasciculi* of Fibres, which make the *Protuberantia annularis* of Dr. *Willis*.
- M.** The *Medulla oblongata*, *sen Medullæ Spinalis principium*. This, as likewise the former body (*L L*) by Dr. *Willis*, are both called *Medulla oblongata*; but I think there is great reason to distinguish them, since Nature has so remarkably done it to our hands; for the Surface of one is striated, the other plain; the former is common to the *Cerebrum* and *Cerebellum*; the latter is conjoyned to neither of them, but immediately to the *Caudex*.
- N N.** The Olfactory, or first pair of Nerves, where it is observable.
- o o o o.* Its double Origination, not before remarked.
- P P.** The Optic, or Second pair of Nerves.
- Q Q.** Of the *Thalami nervorum Opticorum*.
- r r.* The Motory, or Third pair of Nerves.
- s s.* The Pathetic, or Fourth pair of Nerves.
- t t.* The Fifth pair of Nerves
- v v.* The Sixth pair of Nerves.
- w w.* The Auditory, or Seventh pair of Nerves, which are double.
- x x.* The *Par vagum*, or Eighth pair of Nerves.
- y y.* The accessory Nerve, that runs to the *Par vagum*, or Eighth pair.
- z z.* The Ninth pair of Nerves.
- a a.* The Tenth pair of Nerves.



W. Faithorne. del. et sculp.

Tab. XLIX.

This Table was made from the Brain of a Blackmore taken out as the former; only here the *Cerebellum* is turned over to the fore-part of the Brain, by which means are discovered these following Parts.

A A. **T**He Ventricles, and in them the running of the Fibers, which were finer in Nature, then is here represented.

B B. The *Fornix*.

c. The *Glandula Pinealis* is so called, as conceived to resemble a Pine Nut.

d d. The *Protuberantia Natiformes*.

e e. The *Testes*.

F F. The *Thalami Nervorum Opticorum*, which are here divided and broken asunder by turning over the *Cerebellum*, but naturally are joyned.

g g. The Optick Nerves.

h h. The Olfactory Nerves and their double Origination.

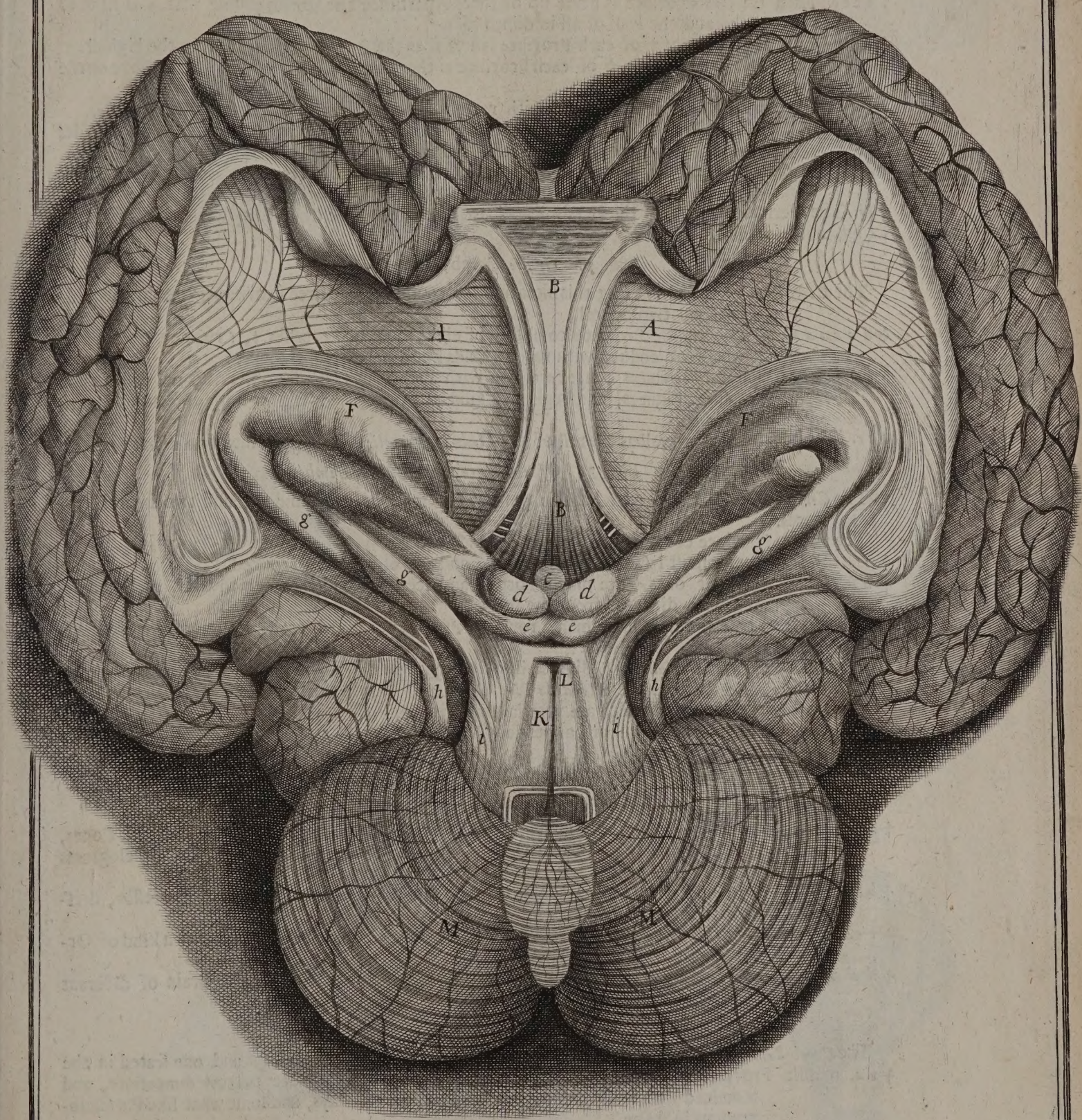
i i. The Processes from the *Cerebellum* to the *Caudex Medullaris*, which make the *Protuberantia annularis*.

k. The *Scobs* which makes the fourth Ventricle.

l. A passage which leads to the third Ventricle under the *Nates* and *Testes*, and so runs to the *Infundibulum*.

M M. The *Cerebellum*.

Tab. L.



W. Faithorne del: et sculp.

Tab. L. Fig. 1.

- † *AA.* The *Cerebellum* of a Man taken out of the Skull, and the Brain turned up †, in which many *Anfractus* may be seen.
- † *aa.* The Vermiform Process †, seated in the middle of the *Cerebellum*, being larger in its Origen and more small in its Termination.
- † *bbb.* The Lateral Provinces †, or Hemisphæres placed on each side of the Vermiform Process.
- † *ccc.* Each Lateral Province is made up of three Apartiments or Stories; The first † is next to the Brain, and the least of all in dimensions.
- † *ddd.* The middle Story † of each Province is less then the Posterior, and less then the highest.
- † *eee.* The lowest Apartiment † of each Province is the greatest of all, and confineth above on the middle Story.
- † *fffff.* Each Hemisphere is shaded with various Blood-vessels †, intersecting the *Lamella*.
- † *ggggg.* The *Lamellæ* † are so many greater or less Semicircles running cross-ways in Parallel lines, adorning the Stories of each Province.
- † *hh.* The Origen † of the *Cerebellum*, the Apices of the Hemisphæres, where it is affixed to the Brain.
- † *ii.* The Terminations † of the Hemisphæres, or Provinces of the *Cerebellum*, which are beset with
- † *kkk.* numerous small Glands †.

Fig. 2. Of the *Cerebellum* of a Calf.

The *Cerebellum* of a Calf having this situation, is composed of three Provinces, one in the middle, and two lateral.

- † *aaaaaaa.* The middle Province consisteth of eight ranks of Processes †, (running cross-ways) which are endued with various kinds of irregular Figures.
- † *bbb.* The Lateral Provinces † are furnished with numerous Processes observing no order, nor determinate Figures, and begin in a kind of Points, and end in large dimensions, with round heads.
- † *cc.* The beginning † as well as the rest of the *Medulla Spinalis*, is divided into two equal parts.

Fig. 3. Of the *Cerebellum* of a Lamb.

The *Cerebellum* of a Lamb (having this position) is made up of a middle, and two lateral Provinces.

The middle Province consisteth of four ranks of Provinces.

- † *aa.* The two uppermost rows go cross-ways †, and are oblong and crooked.
- † *bb.* The two lower ones † are much shorter, and seem to tend right downward, and have Figures much different from the former.
- † *cccccc.* The Lateral † have many rows of Processes, endued with different irregular Figures.
- † *dd.* Part of the *Medulla Spinalis* †, divided into two equal portions by a kind of Fissure, and near the
- † *e.* *Cerebellum*, may be seen the *Glandula Pinealis* †, and below this Gland may be discerned the
- † *ff.* Nativiform Processes †, which are very large in this Animal.
- † *gg.* The Testiform Processes † are appendant to the Nativiform, and seem to encircle their lower Regions as with a double Arch.

Fig. 4. Of the *Cerebellum* of a Pig.

The *Cerebellum* of a Pig is composed of three Provinces, a middle and two lateral ones.

- † *aa.* The middle Apartiment † begins and ends in smaller dimensions in a kind of obtuse Cones, and is made up of many Processes (running cross-ways) resembling a sort of Parallelograms in Figure.
- † *bbbbbbb.* The lateral Provinces † consist on each side of three or four rows of Processes, dressed with different shapes.
- † *cc.* Not far from the *Cerebellum* may be seen the Nativiform Processes † endued with a kind of Orbicular Figure.
- † *ddd.* Above them may be seen some other Medullary Processes † of the Brain of different Magnitudes and Figures.

Fig. 5. Of the *Cerebellum* of a Spaniel Bitch.

The *Cerebellum* of a Bitch, is framed of many Provinces, two lateral ones; and one seated in the

† *aa.* middle Province † hath a more large Origen, and ends in more narrow dimensions, and is endued with many oblong Processes going cross-ways, and some what like Parallelograms in shape.

- † *bbbbbbb.* The lateral Provinces consist of divers ranks of Processes † which seem to be five on one side, and three on the other; near the Origen of the *Cerebellum* may be discerned the Testiform Prominencies, encompassing the lower Region of the Nativiform Processes.
- † *cc.* In this Animal the Nativiform Processes † do adjoyn to the Terminations of the *Thalami Nervo-*
- † *dd.* *rum Opticorum* † parted from each other by a Fissure †.

Fig. 6. The *Cerebellum* of a Doe.

The *Cerebellum* of a Doe is composed of one middle and two or three lateral Apartiments.

- † *aa.* The middle Province † is much larger then the other, and is made up of many oblong transverse Processes.
- † *bbbbbbb.* The lateral Apartiments, † are three on each side, of which the largest encircles the middle Province.

Fig. 1.

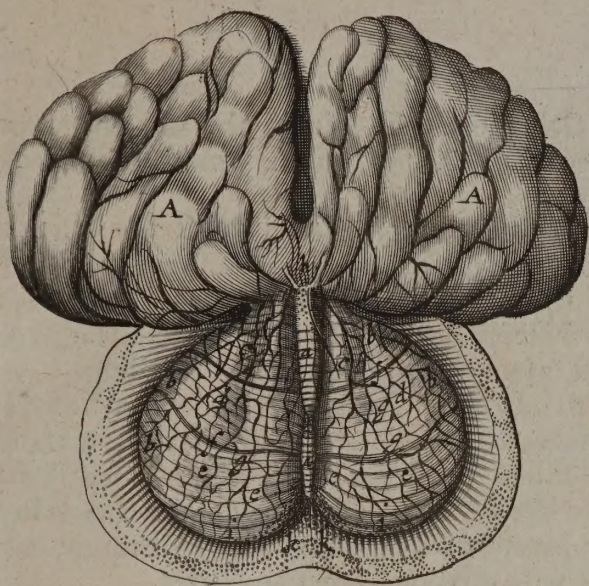


Fig. 2.



Fig. 3.

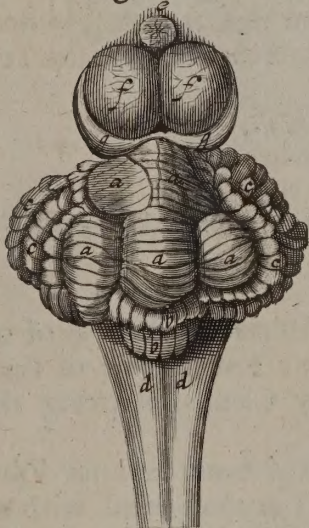


Fig. 4.

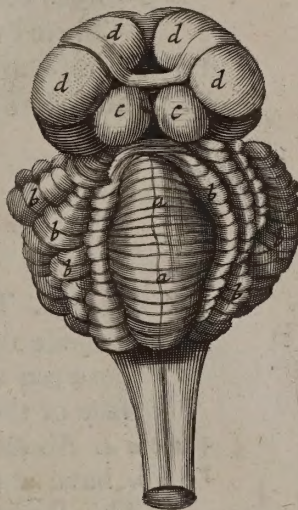


Fig. 5.

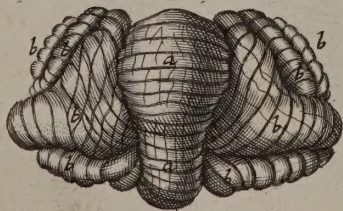
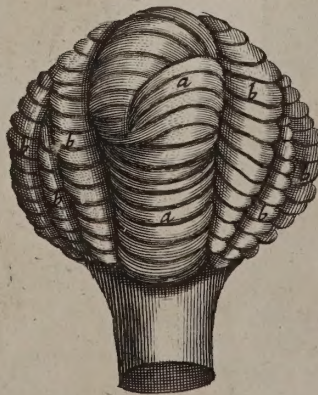


Fig. 6.



Tab. L I. Fig. 1. *The Brain of a Calfe, taken out of the Skull and opened,*

Near the Origen of the Brain of a Calfe, on each side of the olfactory Nerves, *a a.* are seated two orbicular Proceſſes, endued with a white Medullary ſubſtance.

+ *b.* And about the Origen of the Brain near the Skull, is placed the *Os ſpongioſum* +, full of ſmall Cavities, made for the tranſmiſſion of Air into the Ventricles, and for

+ *c c.* the diſcharge of Recrements out of them, into the Cavities of the Noſtrils +, into

+ *d d.* which are tranſmitted the olfactory Nerves +, which do furniſh the inward coat of the Noſtrils with numerous Fibrils, the immediate Organ of Smelling.

+ *e.* The Brain of a Calfe, and other Animals begin + in ſmall dimenſions, and afterward enlargeth it ſelf, and hath its outward Surface rendred uneven, with many

fffff. *Anfraſtus* + (aſo many Cells of Blood-veſſels for their greater ſecurity) which are not ſo deep as in a Humane Brain. And about the Blood-veſſels lodged

+ *g g g g g g g g.* in the *Anfraſtus*, are ſeated many veſſels + (full of ſerous Liquor, encircled with fine Coats) adorned with diſerſe ſhapes and ſizes.

+ *b b.* The Brain being in ſome part opened, the *Corpus ſtriatum* + may be diſcerned out of its ſituation in the Left ſide of the Brain, in which, being ſcraped, a great company of ſtreaks may be ſeen running croſs-ways, through the Medullary ſubſtance of the Brain.

The Medullary part of the Brain is beſet with numerous ſhapes, running croſsways.

+ *i i.* The Brain being laid open, the natiform Proceſſes + (being appendages of the *Medulla oblongata*) are preſented to our view, which are larger in Beaſts then Men; Theſe Protuberancies have their lower regions encircled with the Teſtiform Proceſſes + as with two Arches.

+ *l.* The *Cerebellum* being taken off, the *Medulla Spinalis* appeareth.

Fig. 2. *The Falciform Proceſs taken out of the Brain.*

+ *A A A A A.* The Falciform Proceſs + of this Animal, as well as of other Animals, is made up of a double Membrane (which is a Duplicature of the *Dura mater*) between which are lodged a number of miliary Glands, beſetting the inward ſurface of the Membranes.

+ *a a a a.* About the middle of this Proceſs are ſeated many carnous Fibres + (which

+ *b b b.* have a power to move the *Dura Meninx*) accompanied with many veſſels +. This Proceſs is much larger then of a Humane Brain, and is different in Figure from it, as no way reſembling a Sickle.

Fig. 1.

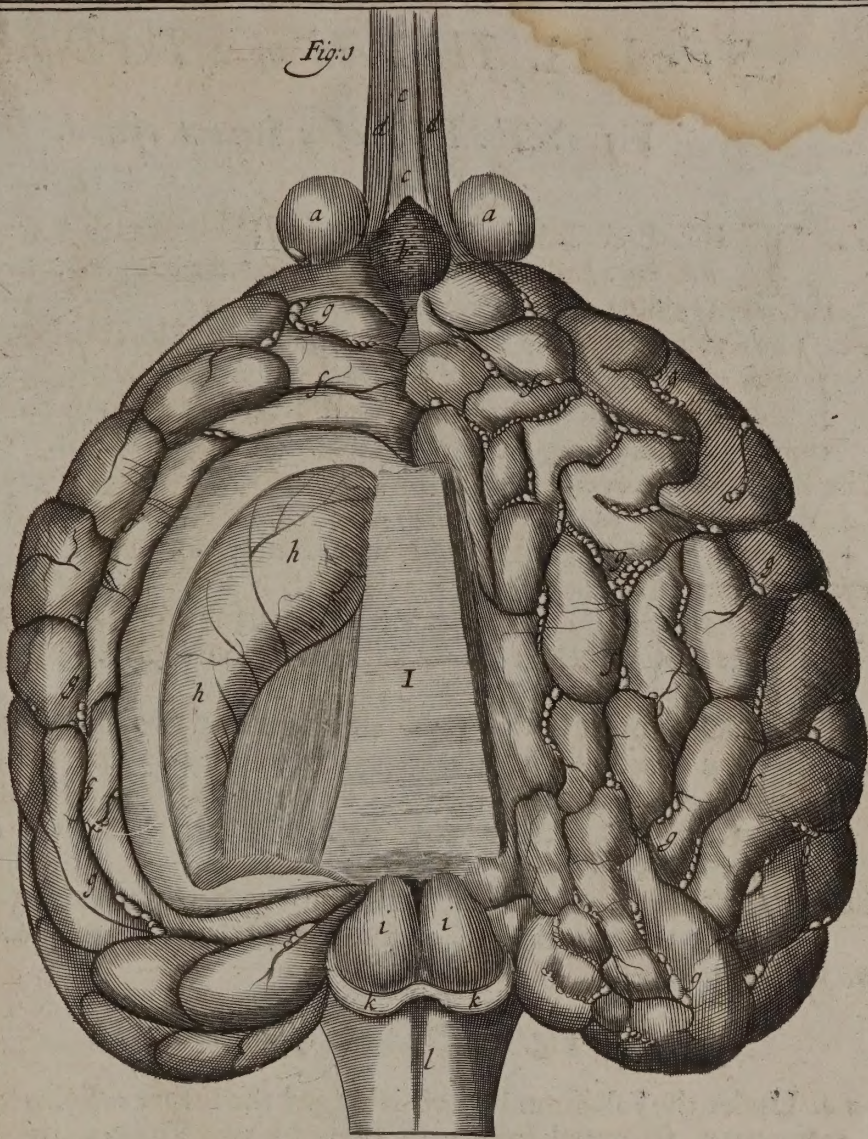
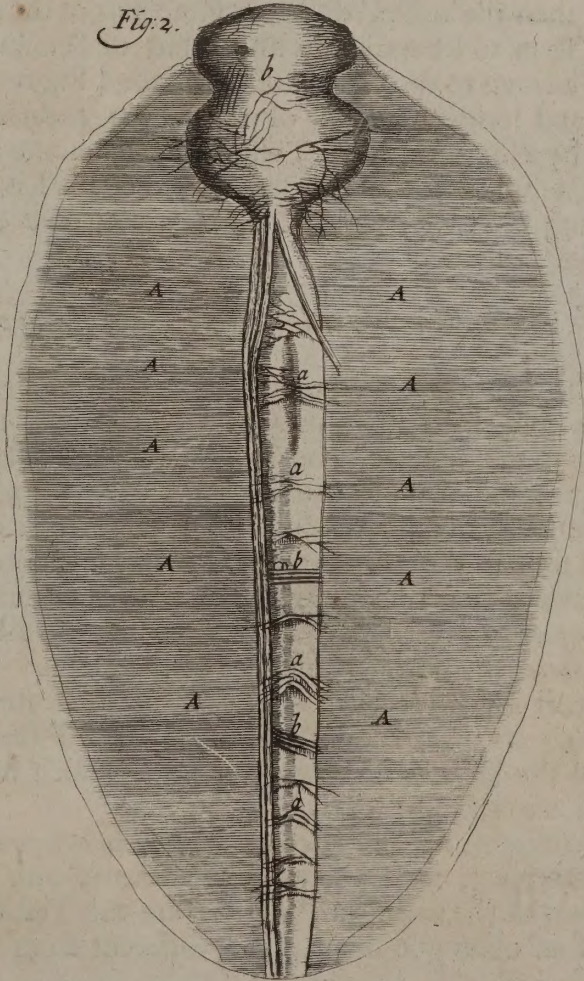


Fig. 2.



Tab. LII. *The Head of a Doe Dissected.*

Fig. 1. *The Brain of a Doe not opened.*

+ a a a a. **T**HE Brain is beautified with two Hemisphaeres + divided in the middle *bb.* by a Fissure + in which is lodged a Duplicature of the *Dura Mater*, commonly called the Falciform Process.

+ c c c c. The serous vesicles + are placed about the Blood-vessels, lodged in the *Anfractus* of the Brain, and are adorned with variety of Figures, some being orbicular, or Oval, others Triangular, or Pyramidal, and appear turgide, with a Liquor, much like *Lympha*, embodied with Particles of Air.

The Brain is first covered with a thick Coat (immediately encircling the *Pia Mater*)
+ d d d. denominated the *Dura Meninx* + which being stripped off, the *Pia Mater*
+ e e. + appears (as being a fine vail immediately encompassing the Brain) shaded
+ f f f f. with fruitful Branches of Blood-vessels + which being conjoyned with numerous *Anfractus* + do resemble a fine Landscip in the *Pia Mater*, when it is divested of the *Dura Mater* turned up, and placed at the Margent of the Brain.

+ i i. Near the Origen of both Hemisphaeres are seated two Medullary Processes + (beautified with a triangular Figure, adjoyning to the olfactory Nerves + inserted at last into the inward Coats of the Nostrils, beset with many Fibrils, the Instrument of
+ k. Smelling. These Nerves are parted by a bony Intersepiment + called vulgarly The Bridge of the Nose.

The Fissure severing one Hemisphere from another, and taking its progress from the Origen to the termination of the Brain, is beset with a great company of small
+ m m. Glands +.

Fig. 2. *The Brain of a Doe opened.*

+ a a a a. Under the Falciform Process is lodged the *Corpus callosum* + which consisteth of
+ b b. many parts, separated from each other by two Fissures, the First + being much shorter then the other, divideth some part of the *Corpus callosum* into equal parts, which seem to be endued with a kind of Semilunary Figure, and their lower Angles adjoyn to the Origen of the Second Figure.

The lower and longer Region of the *Corpus callosum*, is divided also into equal
+ c c. parts (by a longer Fissure +) which begin in acute, and end in more obtuse Cones.
+ d d d d. The Medullary part of this Brain, when opened, is bespecked with many streaks +, passing crosswise, which I humbly conceive are the nervous Fibrils of the Brain.

Fig. 3. *The inward Recesses of the Brain of a Doe opened.*

+ a a. Under the *Corpus callosum*, are lodged the *Corpora striata* +, the Apices of the *Medulla oblongata*, and have their origins endued with obtuse Cones, and their terminations in more acute, contrary to those of a Humane Brain, which begin in more acute, and end in obtuse Cones. The *Corpora striata* in this Animal have
+ b b b b. two oblongue white productions + conjoyned to their terminations, which I have not seen in the Dissection of a Humane Brain.

When the inward penetals of the Brain of this Animal are laid open, on each side of
+ c c c c. the *Corpora striata* appear a white Medullary substance + enamelled with many white *Striae*, the fibrous Compage of the Brain.

+ d d. In the most inward recesses of the Brain, are seated the *Thalami* + *nervorum opti-*
+ e. *corum*, which are parted from each other by a Fissure +, going almost the whole length of the *Thalami nervorum opti-*
+ f. *corum*, which being considered as conjoyned, do constitute a kind of Triangle.

To the lower region of the *Thalami nervorum opti-*
+ f f. *corum*, are adjacent the natiform
+ g g. Protuberancies +, which seem to be adorned with an orbicular Figure, and to the hinder part of the natiform Processes are the Testiforme + appendant, and seem to be of an oblongue shape, much different from the natiform Prominencies.

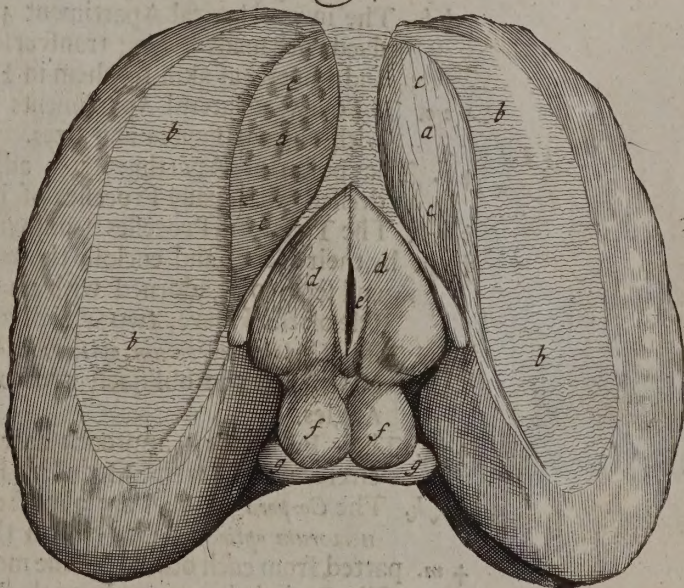
Fig. 1.



Fig. 2.



Fig. 3.



Tab. LIII. Fig. 1. *The Head of a Spaniel Bitch opened.*

- + a a. Two Medullary Processes †, somewhat resembling Glands, are situated near the Origins of
 + b b. the Brain, endued with obtuse Angles †, under which do creep the Olfactory
 + c c. Nerves, running in length † toward the Nostrils.
 + d d d d. The *Anfractus* † of the Brain, are much shallower then that of Man.
 In the *Mæanders* of the Brain relating to this Animal, are seated a company of Blood-ves-
 + e e e e e. sels † divaricated into numerous Branches.
 + f f f. About the Ramulets of many Sanguiducts may be seen divers Vessels of *Lympha* †, or Serous
 Liquor, encompassed with fine Membranes; within the Brain being opened, may be discerned
 + g g g g. a white Medullary substance † dressed with numerous streaks, as with so many Fibrils of
 Nerves.
 + h h. Above the Origins of the *Thalami nervorum opticorum*, may be seen the *Corpora striata* †, begin-
 + i i. ning in large rounded Heads †, and closing in oblong narrow Terminations.
 + k k. The *Thalami nervorum opticorum* † seem to be seated between the *Corpora Striata* and Natiform
 + l l. Processes, to which they appear to be appended by two Processes † as by Stalks; And the *Tha-
 lami nervorum opticorum* are divided from each other by the interposition of two Semicircular
 + m m. Proceses †.
 + n. These white Semicircular Protuberances are also parted by the mediation of a Fissure †.
 + o o. The Natiform Processes †, confining on the *Thalami nervorum opticorum*, are adorned with a
 kind of Oval figure.
 + p p. The Testiform Protuberances † are adjacent to the terminations of the Natiform Processes
 which they seem to enclose with as with a double Arch.
 The *Cerebellum* of this Animal is framed of many Apartments, of which two are seated on each
 side, and one in the middle.
 + q q. The middle Apartment † is endued with a more large Origen, and ends in greater dimen-
 sions, and is beautified with many oblong Processes, going transversely, and resembling
 Parallelogramms in shape.
 + r r r r r r r r. The lateral Provinces are composed of many ranks of Processes †, which seem to be
 five on one side, and three on the other.

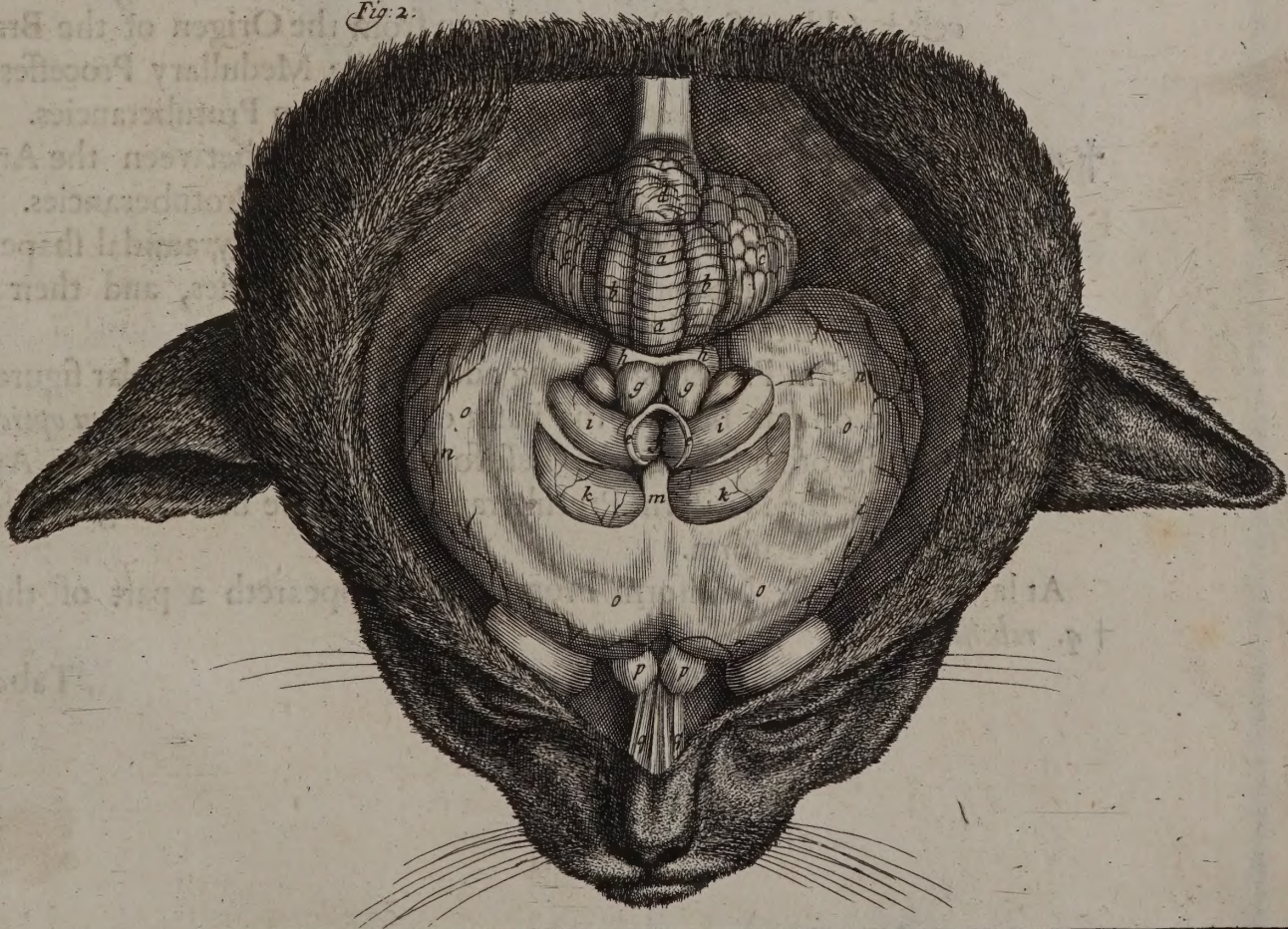
Fig. 2. *The Head of a Cat opened.*

- The *Cerebellum* is composed of six Apartments, one in the middle, and another in the termi-
 nation, and four lateral, two on each side the middle Apartment.
 + a a. The middle Apartment † is adorned with many oblong transverse Processes somewhat like
 Parallelogramms in figure.
 + b b. The inward lateral Apartment † are endued with a kind of Semilunary figure, and are en-
 dued with many oblong transverse Processes more short then those of the middle Apartment,
 and somewhat akin to them in Figure.
 + c c. The outward lateral Apartments † are accommodated with divers ranks of Processes, endued
 with various figures and sizes.
 + d. The posterior Apartments †, adjoining to the middle, is greater and shorter then it, and is
 dressed with many Processes of irregular figures.
 + e e. The Testiform Processes † adjoyn to the Origen of the *Cerebellum*, and are naturally conjoined
 + f f. by their Neck, and enclose the terminations of the Natiform Processes †, placed above them,
 and seem to be adorned with an oval shape; above the Natiform Processes I observed on each
 side of the Fissure, two Semicircular, narrow, Medullary Processes, encompassing it.
 + g g. The *Thalami nervorum opticorum* † in a Cat, have their Butt-ends approaching toward each
 other, and run obliquely cross-ways toward the sides of the Brain, and end in more acute
 Angles.
 + h h. Their Butt-ends † approach near each other (as only parted by a narrow Fissure) and are en-
 circled with a white Medullary Process.
 + i i. The *Corpora striata* † are almost of the same length, figure, and magnitude, with the *Thalami
 nervorum opticorum*; to which the lentiform Processes are adjacent, and their Butt-ends are
 + k k. parted from each other, by the mediation of a short and narrow medullary Process †.
 + l l. The Brain being opened, at the Margent of it may be seen some remanent *Anfractus* †.
 And within the *Anfractus* of the Brain opened, may be observed two Semicircular medullary Pro-
 + m m. cesses † of it.
 + n n. At the Origins of the Brain are seated two medullary Processes †, beautified with a trian-
 gular Figure.
 + o o. Under these medullary Processes, do creep divers Branches of the Olfactory Nerves †.

Fig. 1



Fig. 2

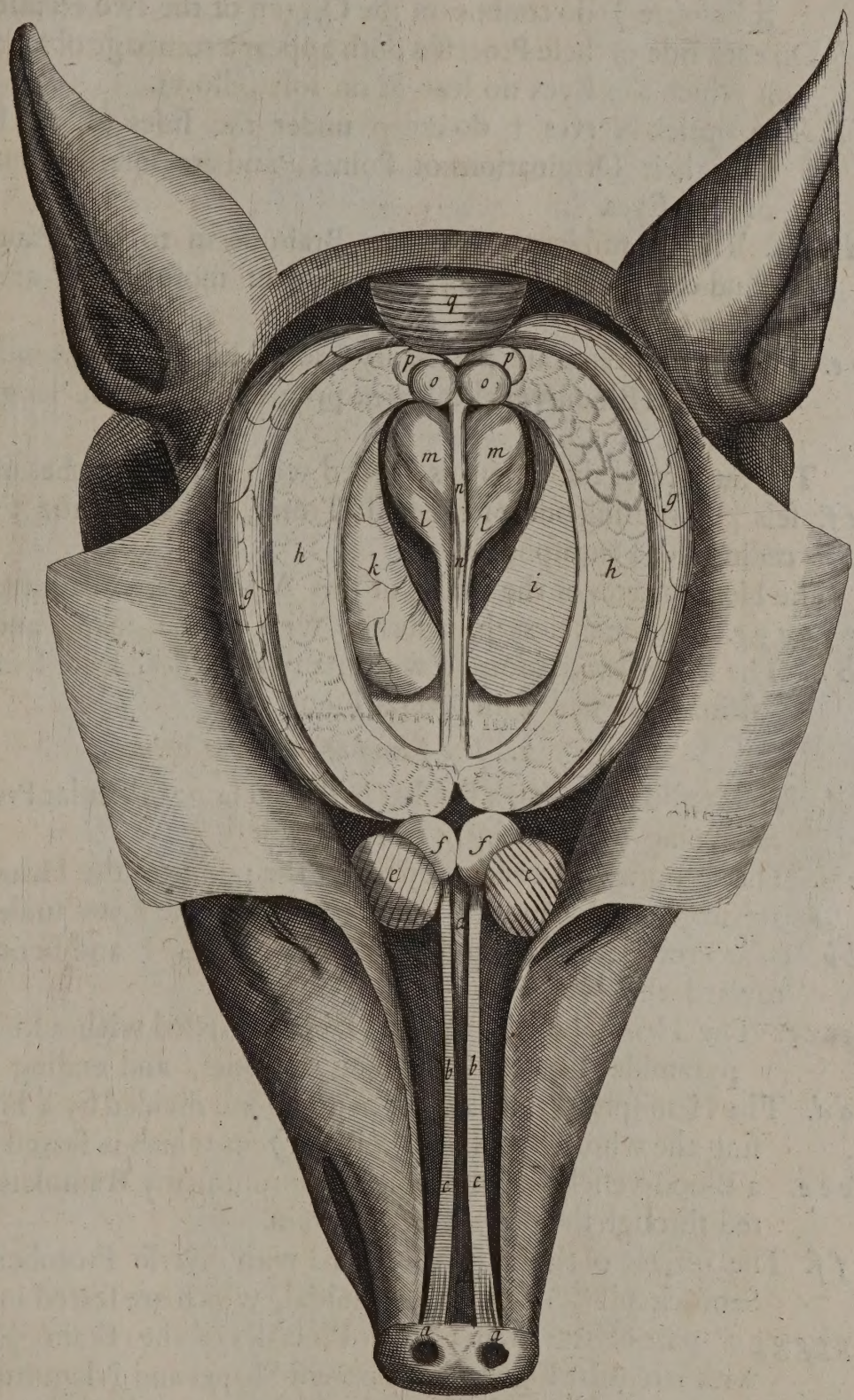


Tab. LIV. *The Head of a Pigg opened.*

- † *aa.* **T**He Olfactory Nerves near their terminations do divide into many small Fibrils †, seated near the beginning of the Nostrils for the greater advantage of a quick sensation.
- † *bb bb.* The Trunks of the Olfactory Nerves † which creep out of the Brain and take their progress the whole length of the Nostrils, on each side of the grisly Intersepiment †, parting the Nostrils.
- † *cc.* A double Case † (is lodged near the Origination of the Trunks of Nerves when crept out of the Brain) beset with many Cartilaginous Lines, passing cross-ways. Within the said Cases as in a Cabinet, are kept two soft medullary substances, not unlike that of the Brain.
- † *ff.* About the Origens of the Brain are seated two other Processes † (endued with an Oval figure and a Medullary substance) somewhat less then the other, contained in two Cartilaginous Repositories.
- † *gg.* About the circumference of the Brain (left unopened) may be discerned some *Anfractus* †, the allodgements of Blood-vessels; within the *Anfractus* (the Brain being opened) may be seen a white Medullary substance, consisting of many small Globules †, and if you
- † *h h.* divest a *Corpus striatum* † of its Membrane, and gently scrape it, we may discover its Surface, enameled with numerous streaks (running cross-ways) which are a system of Nervous Fibrils.
- † *k.* And if the *Corpus striatum* be encompassed with its thin Membrane many Blood-vessels † appear, shading the Surface of the Lentiform Process.
- † *ll.* Two oblong narrow medullary Processes †, may be seen, which encircle a great part of the *Thalami nervorum opticorum*, as with two Arms,
- † *mm.* And the Brain being opened may be observed an oblong narrow Process † (like a Staff) going down from the Origen of the Brain all along it, and between the Arms of the Medullary Processes, and *Thalami nervorum opticorum*, to the Natiform Protuberancies.
- † *nn.* The *Thalami nervorum opticorum* † are lodged between the Arms of the said Medullary Processes and the Natiform Protuberancies. The *Thalami nervorum opticorum* are endued with a Pyramidal shape, and their Bases confine on the Natiform Prominencies, and their acute Cones, on the Arches of the Medullary Processes.
- † *oo.* The Natiform Processes (being adorned with an Orbicular figure) do adjoyn on one side of the Bases of the *Thalami nervorum opticorum*,
- † *pp.* and on the other side to the Testiform Processes †, which are Appendages of the Natiform Protuberancies, and are more long and slender then the Natiform.

At last beyond the Natiform Prominencies appeareth a part of the Cerebellum.

Tab. LV.

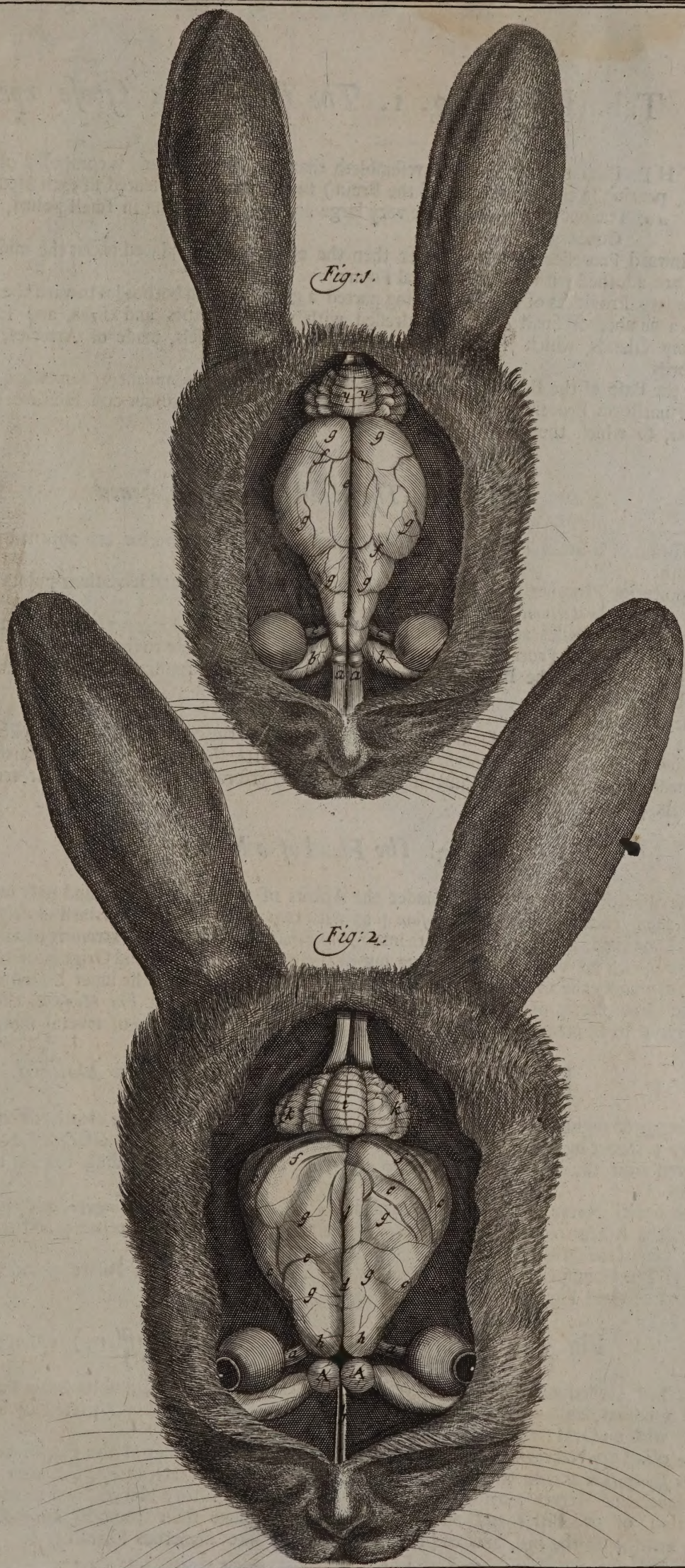


Tab. LV. Fig. 1. *The Head of a Rabbet opened.*

- † *a a.* **T**WO Processes † of a Rabbet (endued with an orbicular Figure) do confine on the Origen of the two Hemisphæres.
- † *b b.* On each side of these Processes doth appear a compage of many Glands †, on which the Eyes do lean as on soft pillows.
- † *c c.* The optick Nerves † do creep under the sides of the Hemisphære, near their Originations or Points; and are inserted into the inside of the Eyes.
- † *d d d d.* The Hemisphæres † of the Brain seem to be beautified with a kind of conical Figure, beginning in more acute, and ending in blunt Cones.
- † *e e.* The Hemisphæres are parted by a long Fissure †, in which, as in a Trench, a Blood-vessel takes its progress the whole length of the division.
- The Surface of the Brain is shaded with many Branches of Blood-vessels † sprouting out of the said Trunk, seated in the Fissure, interceding the Hemisphæres.
- † *g g g g g g.* The Hemisphæres of the Brain of this Animal, are beautified with many Prominencies †, adorned with various shapes and sizes.
- † *h h h.* The *Cerebellum*, adorned with many Processes, seated in various positions, dressed with several Figures.

Fig. 2. *The Head of a Hare opened.*

- † *A A.* A Hare also as well as a Rabbet hath two large orbicular Protuberances † adjoining to the Origenes of the Brain.
- † *a a.* The † optick Nerves creep under the points of the Hemisphæres, and are implanted into the inner region of the Eyes under these orbicular Processes do creep the olfactory Nerves † and bend their course toward the Nostrils.
- † *b b b.* The Hemisphæres † of the Brain are dressed with a kind of inverted pyramidal Figure, beginning in Cones, and ending in Bases.
- † *d d.* The Hemisphæres also of this Animal are divided by a Fissure † (passing the whole length of the Brain) in which is seated the Trunk of a Blood-vessel, out of which do sprout many Ramulets † divaricated through the Surface of the Brain.
- † *e e e.* The Surface of the Brain is adorned with diverse Protuberances † some Semi-circular, or rather Pyramidal, which are seated in the posterior part of the Brain; other Processes of the Brain † are endued with irregular Figures of different Shapes and Magnitudes.
- † *h h.* The Anterior Processes † of the Brain seem to be adorned with a kind of Pyramidal Figure.
- The *Cerebellum* of the Animal hath diverse Apartments, composed of one middle, to which on each side a double lateral adjoyneth.
- † *i i.* The middle Apartment † somewhat resembleth the Vermiform Protuberance of a Humane Brain, and is somewhat of an Oval Figure, and is dressed with many Processes passing in transverse positions, somewhat like Parallelograms.
- † *k k k k k k.* The lateral are seated on each side of the middle Apartment, and are beautified with various Processes of different Figures, some being Pyramidal, others out, and a third Conical, and a fourth irregular.



Tab. LVI. Fig. 1. *The Head of a Goose opened,*

TH E Brain of a Goose much resembleth that of a Bustard, and is composed of Four Processes (appearing in the upper part of the Brain) two of which are seated in each Mediety.

- a a.* The outward Processes are very large and long, beginning in small points, and ending in blunt Cones.
b b. The inward Processes are much smaller then the other, and are placed about the middle of the long *Sinus*, and are adorned with a kind of Oval Figure.
 In the two Provinces of the Brain being parted a good space on both sides toward the Base, may be discerned a number of small Globules, dressed with various shapes and sizes, and seem to resemble so many Glands, which I conceive to be *Systemes* of Vessels, made of Arteries, Veins, and nervous Fibrils.
 Near the Base of the Brain is seated on each side an Oval Prominency (somewhat resembling in Figure the natiform Procelle of a Humane Brain;) and are like in colour and substance to the *Medulla oblongata*, to which they are appendant as its Processes.

Fig. 2. *The Head of a Swan opened.*

- a a.* The Brain of a Swan is composed of six Processes, the two anterior are adorned with a kind of Oval Figure.
b b. The posterior Processes are endued with a Semi-circular Shape, and have their points below joyned on each side of the *Cerebellum*.
c c. The interior Processes are also two in number, of a pyramidal Figure, and agree in their Apices, or points above to the Oval Processes, and do terminate in their Cones below to the Processes of the Semicircular.
d d. In the middle of the Brain, is seated a Falciform Process, running all along from the anterior to the posterior part,
+ e e. The *Cerebellum* +.
+ f f. The olfactory Nerves + seem to take their rise under the Second pair of Processes, and passing on the sides of the orbicular Processes, do afterward encircle the *Os spongiosum*, and terminate into many Filaments + (the Organs of Smelling) about the Perforations, placed not far from the middle of the
+ g g. Beak +.
+ b b. Beak +.

Fig. 3. *The Head of a Mallard opened.*

- + a a.* The olfactory Nerves + creep under the Apices of the Hemisphaeres, and pass over the optick Nerves,
+ b. and then encircle the *Os spongiosum* + as with two Arches, and afterward closely approach each other
+ c. for some time, and at last terminate into many Filaments + near the extremity of the upper Beak.
+ d d. The optick Nerves + seem to come out of the *Medulla oblongata*, and Origens of the Hemisphaeres, and creep under the olfactory Nerves, and then are implanted into the inner region of the Eyes.
+ e e. The Hemisphaeres of the Brain + being divested of the *Dura* and *Pia Meninx*, the Brain may be discovered to be made up of many little Globules + which are *Systemes* of several minute Vessels.
+ f f f f. vered to be made up of many little Globules + which are *Systemes* of several minute Vessels.

Fig. 4. *The lower region of the Brain of a Mallard.*

- In the lower region of the Brain of a Mallard, the Nerves may be more clearly discovered, and the Auditory + sprouting out of the *Medulla oblongata*, and passing under the olfactory Nerves, which are also
+ a a. derived from the said *Medulla*, and encompass the *Os spongiosum* + tending toward the extremity of the Bill.
+ b. derived from the said *Medulla*, and encompass the *Os spongiosum* + tending toward the extremity of the Bill.
+ c c. The optick Nerves + do proceed more highly out of the *Medulla oblongata*, and make their egress near
+ d d. + *e.* the Apices of the Hemisphaeres + and afterward intersect each other + and then pass obliquely toward the Orbs of the Eyes.
+ f f. + *g g.* The Hemisphaeres + of the Brain are parted in the midst by a Fissure + and are beautified with a kind of Oval Figure.

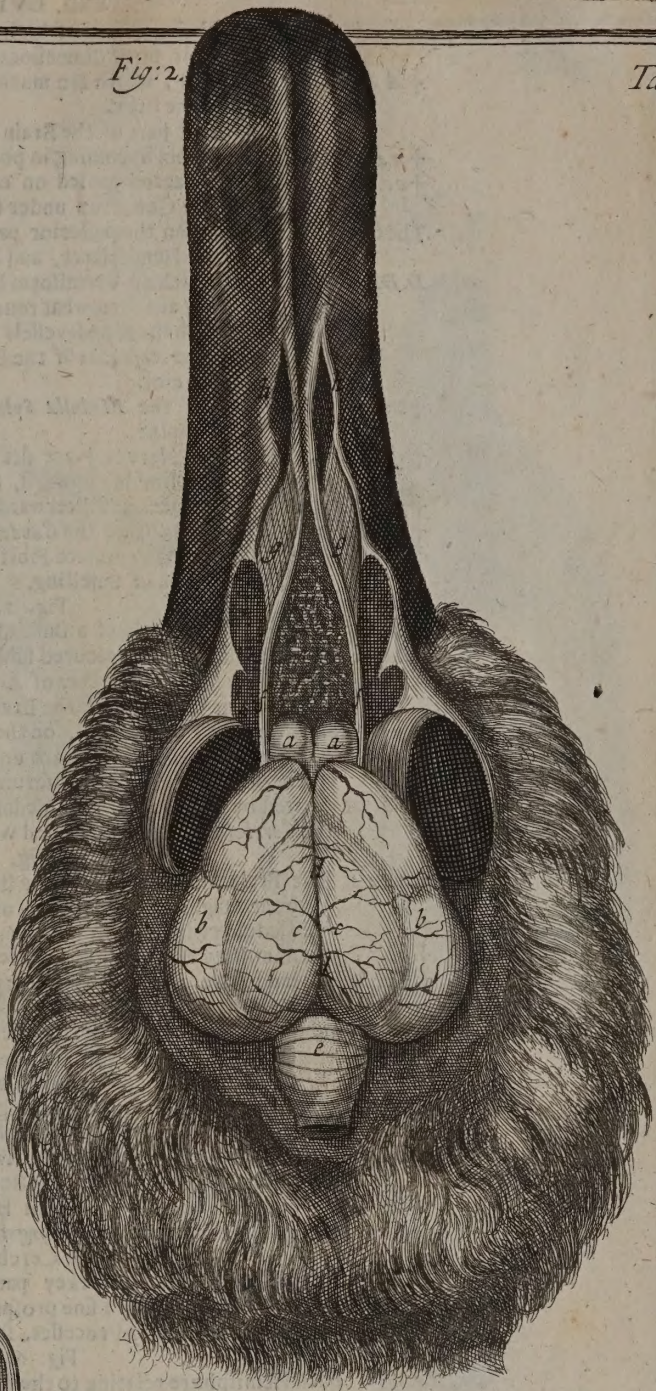
Fig. 5. *The Head of a Bird (called a Shuffler) opened.*

- The Bird (called a Shuffler) much resembleth a Mallard in Figure, and its Brain hath a great likeness in
+ a a. + *b b.* colour, substance and shape in reference to its Hemisphaeres + (parted by a Fissure +) adorned with an Oval shape.
+ c c. The olfactory Nerves + come out of the Brain about the Origens of the Hemisphaeres, and encircle the *Os spongiosum* as with two Arches, and then closely associate each other, and after a small space, have
+ d d. branches of Nerves + arising out of the Trunk of the olfactory Nerves, and terminate near the perforation of the Bill + and afterward the Trunks make their progress on each side the Intersepi-
+ e e. ment + of the Bill, and end near its extremity into numerous Filaments +.
+ f. + *g g.* ment + of the Bill, and end near its extremity into numerous Filaments +.

Fig. 1.



Fig. 2.



Tab. 56.

Fig. 3.



Fig. 4.

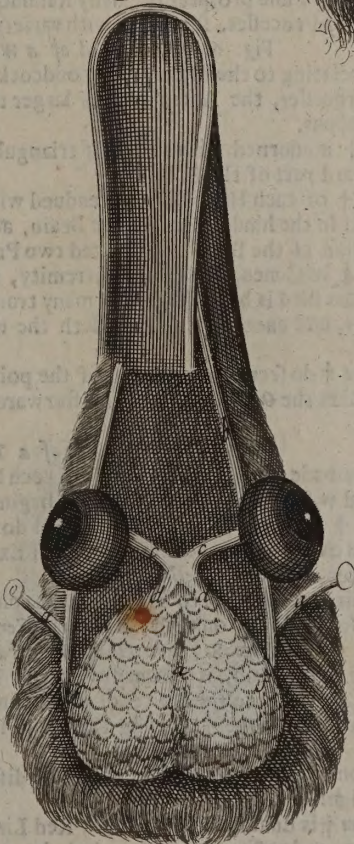
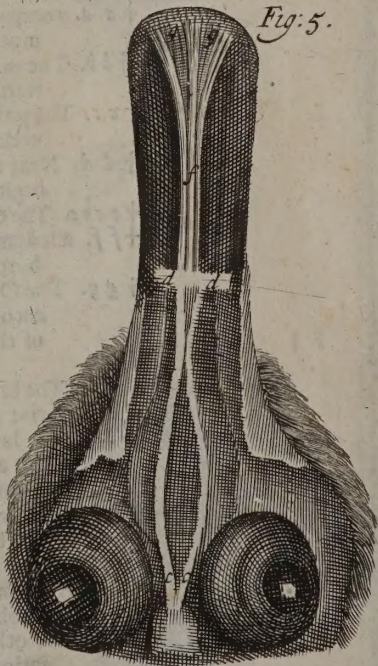


Fig. 5.



Tab. LVII. Fig. 1. *The Head of a Bustard opened.*

A Bustard being a Bird of high esteem, as having a Body as good in quality as great in bulk, is endued with a Brain (of small dimensions) which consisteth of two Hemispheres, parted from each other by a long
 † *AA.* Fissure or *Sinus* †, which are much larger in their Posterior Regions or Butt ends, and begin in narrow points, or Apices near the Beak.

The great part of the Brain is framed of two large Processes (which make the Hemispheres of the Brain)
 † *aa.* † *bb.* each of them beginning in points † placed near the Eyes, and terminate into round Protuberances †.

† *cc.* The *Cerebellum* is accompanied on each side with an oval Process †, whose acute points confine on the *Cerebellum*, and their blunt Cones run under the sides of the Brain, tending forward.

The *Cerebellum* is seated on the posterior part of the Brain, and insinuates it self a good space between the two blunt Cones of each Hemisphere, and is fastened to the inside of them, not far distant from the middle.

† *DD.* This *Cerebellum* hath no Vermiform Process, but many *Lamellae* †, resembling a kind of Parallelograms, and differ only as they are somewhat rounded in their terminations; these oblong Processes have some obscure partitions, in which the Blood-vessels are allodged; and upon this account these Processes of the *Cerebellum* have analogy with the *Anfractus* of the Brain (relating to other more perfect Animals,) as they are Repositories of Arteries and Veins.

† *ee.* The beginning of the *Medulla Spinalis* † is parted in the middle into equal parts, and so continues the whole length of the Spine.

† *ffff.* The Olfactory Nerves † are derived from two Prominencies, adjoining to the anterior part of the *Medulla oblongata*, and climbing upward, creep out of the Brain, near the Apices of the Hemispheres, and are con-

† *gg.* joined for some space, and afterward part, encircling the *Os spongiosum* †, and then unite again; and after a little

† *bb.* space, are emitted out of the *Candex* of the conjoined Nerves, (to a Branch resembling a kind of Arch †) which

† *iiii.* terminate into many minute Fibrils †, seated about the two oblong *Foramina* perforating the upper Beak, the immediate Organ of Smelling.

Fig. 2. *The Brain of a Bustard opened.*

Both Provinces of the Brain of a Bustard being opened and turned on each side, the greatest part appeareth Cortical,
 † *aaaa.* endued with an Ash-coloured substance, made up of numerous small Globules † (of various sizes) Enamelled with many minute branches of Arteries and Veins, interspersed with very small nervous Fibrils, as being the most proper Compag of the Brain.

Under the two Hemispheres, on the upper Region of the *Medulla oblongata*, are seated two Oval Processes, with

† *bb.* † *cc.* oblong Necks †, which are united near the anterior part of the Brain; and two other Processes † are placed on the posterior part of the former oval Prominencies, which are less, and endued also with an Oval Figure, and

† *dd.* are united by a narrow oblong Medullary substance †. And are lodged in some part near the anterior Region of the *Cerebellum*, which is endued with a White Process, fastning it to the *Medulla oblongata*.

Fig. 3. *The Brain of a Turkey opened.*

† *aaaa.* The Brain of a Turkey being stripped of its Coats and laid open, seemeth to consist of many Globules † of different magnitudes, and many of them are endued with an orbicular Figure; and are framed of a Cortical and Medullary substance.

† *bb.* The Mammillary Processes † are dressed with a kind of triangular Figure, and are seated near the Origen of the
 † *cc.* Brain, and have a pair of Olfactory Nerves † creeping under them out of the Brain into the Membrane, lining the Nostrils.

About the termination of the Brain, are lodged two Medullary Processes, beautified with an Oval Figure (somewhat

† *d.* resembling the Natiform Processes) and are tied together by the interposition of an oblong Medullary Process †.
 † *ee.* † *ffff.* The *Cerebellum* beginneth and endeth in blunt Cones † and is adorned with oblong Processes † running cross-ways, somewhat resembling *Lamellae*.

Fig. 4. *The Brain of a Turkey taken out of the Skull and opened.*

The Medullary part of the Brain of a Turkey seemeth to be full of streaks, which are Nervous Fibrils, and many small Prominencies, which are Bodies aggregated of variety of Vessels.

† *aa.* Near the hinder part of the Brain is seated the Origen of the *Medulla Spinalis* † which is nothing else but the elongation of the *Medulla oblongata*.

Fig. 5. *The Cerebellum of a Turkey taken out of the Skull and Dissected.*

The *Cerebellum* of a Turkey parted from the Brain, and taken out of the Skull, when it is variously opened
 † *aaaa.* with a Knife, it giveth a fine prospect of many Ramifications, resembling the Branches of Trees †, which are numerous Medullary Processes, furnished with variety of Vessels.

Fig. 6. *The Head of a Woodcock opened.*

Each Hemisphere relating to the Brain of a Woodcock, may (if inspected with a curious Eye) be seen to be
 † *aa.* composed of three Processes, the Anterior † is larger than both the other, and begins in a point, and endeth in much larger dimensions.

† *bb.* The middle Process † is adorned with a kind of triangular Figure, having its Base outwardly, and its pointed toward the more inward part of the Brain.

† *cc.* The posterior Process † of each Hemisphere is endued with an irregular shape, and beginneth more narrow, and endeth more dilated in the hinder part of the Brain, adjoining to the Natiform Processes.

† *dd.* Near the hinder Region of the Brain are situated two Processes † endued with a kind of Semicircular Figure, beginning and ending in Cones, and in one Extremity, adjoined to each side of the *Cerebellum* near its Origen.

† *eee.* The *Cerebellum* of this Bird is beautified with many transverse Lines, as being numerous *Lamellae* †, the various
 † *ff.* allodgments of Vessels, and another Line † passeth the whole length of the *Lamellae*, almost from the top to the bottom.

† *gg.* The Olfactory Nerves † do seem to spring out of the points of the Anterior Processes, and after a little space do encompass with Arches the *Os spongiosum*, and afterward unite again, and make their progress the whole length of the Bill.

Fig. 7. *The Head of a Teal opened.*

The Brain of a Teal is made up of six Processes, as each Hemisphere is graced with three Processes, the two An-

† *aa.* terior † are beautified with a kind of Oval Figure, beginning in acute, and ending in more obtuse Cones.

† *bb.* The lateral Processes † have a triangular Figure, and do enclose within their Angles the inferior Processes, which are adorned with an oval Figure, beginning in small Extremities, and end into more blunt round Heads, adjoining to the Origen of the *Cerebellum*.

† *cc.* The *Cerebellum* † in this Bird seemeth to be double, as consisting of two Natiform Processes, on which do confine

† *dd.* two orbicular Processes † seated on each side of the *Cerebellum*.

Fig. 8. *The Head of a Jack Snipe opened.*

† *aa.* A Snipe, in reference to its Brain, is adorned with four Processes, the anterior † are very small (endued with an oblong Figure) adjoining to the Apices of the Brain.

† *bb.* The other Processes are very large †, taking their rise in small Extremities, and have much greater Terminations.

† *cc.* Near the hinder Region two other Processes † may be discerned, which lean upon the *Cerebellum*, and are dressed with a kind of oval Figure.

† *dd.* † *eee.* The *Cerebellum* † is Enamelled with many Red Lines running cross-ways, and have two other Lines † intersecting the former, and passing down the whole length of the *Cerebellum*.

Tab. LVIII. Fig. 1. *The Head of a Curlew opened.*

+ a a. **T**he Head of a Curlew being opened, we may take the prospect of its Brain, beautified with two Hemispheres + divided by a long Fissure.

These two Provinces of the Brain have their Apices, adjoining above to the Olfactory Nerves, and their Terminations leaning upon two Processes, somewhat like the Testiform Protuberances of the Brain.

+ b b b b. The Hemispheres are enamelled with variety of Blood-vessels +, divaricated through the *Dura* and *Pia mater*, the fine vails of the Brain.

+ c c c c c. The Hemispheres are rendered uneven by many Risings + of different Figures and Magnitudes, in which they seem to resemble various Processes.

Between the Termination of the Hemispheres, and the Origen of the *Cerebellum*, are seated two oblong narrow Processes + of a Semicircular Figure, not unlike the Testiform Prominencies of the Brain.

+ e e e e. The *Cerebellum* + hath many transverse Processes, somewhat like Parallelograms, and is adorned with a kind of an inverted Pyramidal Figure, as the Base being turned upward, and the Cone downward.

Fig. 2. *The Head of a Godwit opened.*

+ a a a a. A Godwit being highly esteemed for its delicacy of Flesh, hath a Brain beautified with two Hemispheres + parted by + b b. + c c. a long Fissure, dressed with oval Figures, having their greater Extremities + leaning upon the *Cerebellum* + and its adjacent Processes, and its lesser upon the Olfactory Nerves.

+ d d d d d. The upper surface of the Brain is rendered unequal by many unevennesses + seeming to resemble Processes of diverse Figures, some Pyramidal, or Quadrangular, others irregular and difficult to be described.

+ e e. About the Origen of the Brain are placed two small Processes +, (endued with a kind of orbicular Figure) somewhat like Glands.

+ f f. + g g. The Olfactory Nerves +, go first in straight lines, and then pass after the manner of Arches +, encircling the *Os spongiosum*, and afterward make their progress in a direct course the whole length of the Beak.

The *Cerebellum* of this Bird is composed of three Apartments, one being seated in the middle, and one on each side of the greatest Province.

+ b b b b. The middle Apartment + is the largest of all, and begins in a great rounded Head, and terminates in smaller dimensions, + i i. and is beautified with many long and shorter Processes + (going in parallel lines) somewhat resembling Parallelograms in Figure.

+ k k. The lateral Apartments of the *Cerebellum*, seem to be two small Processes + (endued with a Semilunary Figure) encircling the sides of the upper part of the middle Apartment.

+ l l. On the Convex part of these Semilunary Processes do confine two other somewhat larger Processes + which are also adjacent to the Terminations of the Hemispheres, and are endued with different Figures, the one being oval, and the other triangular.

Fig. 3. *The Head of a Virginia-Nightingale opened.*

The Head of a *Virginia* Nightingale hath not only its Brain encircled with two Membranes, but also with two Skulls too, as with more thick Walls, the upper is made of two *Laminae*, interlined with a spongy substance, and the lower Skull is thinner than the other (all beset with fine Down) immediately encompassing the *Dura mater*.

+ a a. The Head being opened, the Brain may be discovered to be composed of two Hemispheres +, graced with a pyramidal Figure, the Bases being the Terminations, and the Cones the Origen of the Brain.

One of the Hemispheres, being invested with its Coats, seemeth to be adorned with three Processes, the first being anterior + is endued with a pyramidal Figure, and exceedeth the other in dimensions.

+ b. The second may be called lateral +, and seemeth to be dressed with a pyramidal Figure, and is crooked, and somewhat Semicircular.

The third being seated in the termination of the Hemispheres, may be named Posterior, and is less than the other, and is adorned with a kind of Semilunary shape.

The other Hemisphere being divested of its Coats, and scraped in its upper surface, doth present the Spectator with a pleasant sight of many Globules, resembling Glands.

+ d. The *Cerebellum* of this Bird is beautified with an Oval Figure; + The smaller Extremity insinuates it self between the termination of the Hemispheres, and the greater end is encircled with a Semicircular Process, which I conceive is part of the *Cerebellum*.

+ e e. On each side of the *Cerebellum* is contiguous a Semilunary Process + enclosing the terminations of the Hemispheres.

+ f f. About the termination of the *Cerebellum* is placed another Process + divided into many partitions, and is embellished with a Semilunary shape.

Fig. 4. *The Head of a Partridge opened.*

+ a a a a. The Brain of a Partridge in its outward surface, is dressed with many Prominencies +, (endued with different Figures + b b. and Magnitudes) and is made up of two Hemispheres +, adorned with a pyramidal Figure, beginning in Cones and ending into Bases, seated in the posterior part of the Brain.

+ c c. The Hemispheres in this Bird (as well as in others) are divided from each other in their ambient parts by a Fissure +.

+ d d. The Olfactory Nerves + are derived from the *Medulla oblongata*, and do seem to make their egress out of the Brain, under the Apices of the Hemispheres.

+ e. The *Cerebellum* + hath its dimensions more enlarged toward the Brain, and more contracted toward the *Medulla Spinalis*, + f f. and is beautified with many Semicircular narrow Processes +, making their progress obliquely cross-ways on each side of + g g. the *Cerebellum*; near its Origen is seated a small Process +, adorned with an oblong oval Figure: Below the *Cerebellum* + h h. may be discerned the *Medulla Spinalis* +, divided into equal parts by a Fissure.

Fig. 5. *The Head of a Pidgeon opened.*

+ a a. The Brain of a Pidgeon is composed of two Hemispheres + which seem to be adorned with a pyramidal, or rather oval + b b. Figure, and are parted by the interposition of a Fissure + (running the length of the Brain) in which is lodged the Fal-ciform Process, being a Duplicature of the *Dura Meninx* in Birds as well as other Animals, and taketh its rise about + c c. the points of the Hemispheres, and passeth all the Fissure, and at last encircles their Terminations, as with two Arches +.

+ d d. The Olfactory Nerves + take their origination out of the *Medulla oblongata*, and seem to creep under the Origen of the Hemispheres.

+ e. + f f. The *Cerebellum* + is endued with a kind of oval Figure, and is dressed with many narrow oblique Processes +, passing cross-ways.

+ g g. To each side of the *Cerebellum* is adjacent a small Protuberance +, beautified with an oval shape.

Fig. 6. *The Head of a Kings-Fisher opened.*

The Brain of a Kings-Fisher seemeth to be beautified with diverse Prominencies of different shapes and sizes, and some of them seem to be pyramidal,

+ a a. The Hemispheres + in this Bird as well as others, begin in points, and end in more enlarged dimensions.

+ b b. The Olfactory Nerves seem to be double, the more outward + take their Origen from the sides of the *Medulla oblongata*, and creep under the Brain, a little space from its Origination.

+ c c. The inward Olfactory Nerves + borrow their rise from the *Medulla oblongata*, and creep under the Origen of the Hemispheres, and pass along towards the Beak.

+ d. The *Cerebellum* + in this Bird is endued with a kind of inverted pyramidal Figure, by reason its Base is upward, and its Cone downward.

Fig. 7. *The Head of a Goose opened.*

This Figure of a Goose is much different from the former, in which the Brain of the Goose is divested of its Coats, and + a a a a. appeareth to be a Systeme of many Globules + (besetting each Hemisphere) composed of several kinds of Vessels, so that they have much affinity with Glands, as being strainers of the Blood, whereby the albuminous part of the Blood is separated from the Red Crassament, in order to the preparation of the Nervous Liquor.

+ b b. The Hemispheres + begin in Apices or Points, and end in much greater rounded Heads, and between passeth a Fissure +, separating the Hemispheres from each other.

+ d. Beyond the Apices of the Hemispheres, is seated the *Os spongiosum* +, adorned with a Conical Figure.

+ e e. The Optick Nerves + take their rise near the Origen of the *Medulla oblongata*, and are inserted into the inward Region of the Eyes.

+ f f. The Olfactory Nerves + sprout out of the sides of the *Medulla oblongata*, and afterward pass over the Optick Nerves, and + g g. encircle the *Os spongiosum* with Arches, and then associate, and out of their Trunks arise on each side a Branch +, and terminate near the perforation of the Bill.

+ h h. + i i. These Trunks of Olfactory Nerves end in two round Protuberancies +, out of which do arise many nervous Fibres + terminating near the Extremity of the Bill.

+ k k. Near the posterior Region of the Brain, is seated the *Cerebellum* +, adorned with an oval Figure, and beset with many oblong narrow Processes, somewhat like Parallelograms in shape.

Fig. 1.

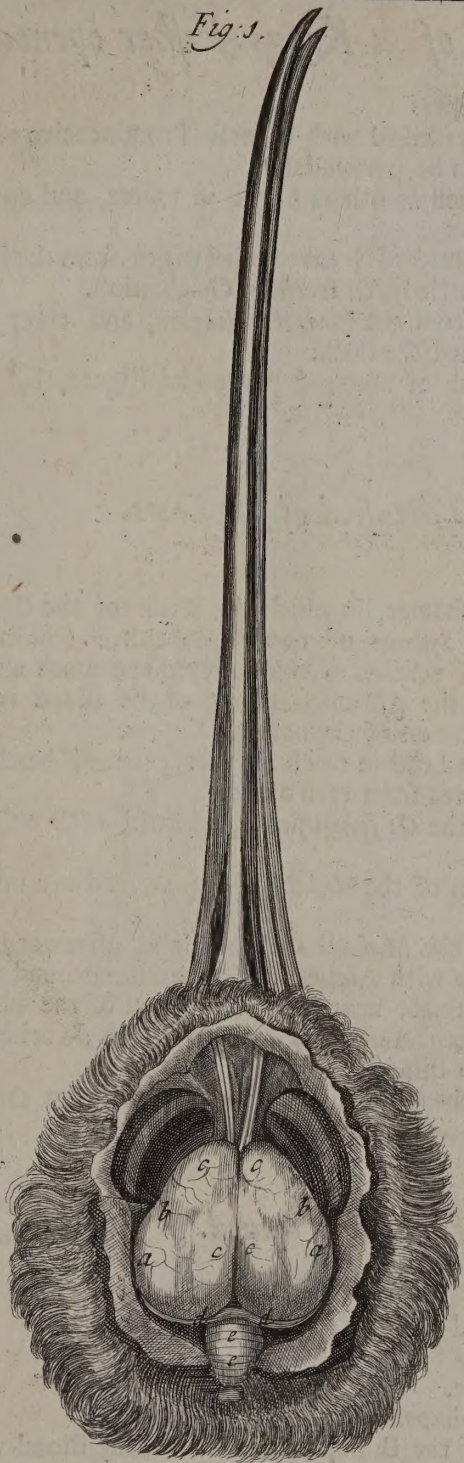


Fig. 2.



Fig. 3.

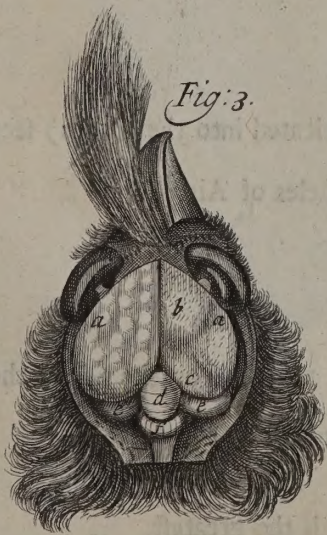


Fig. 4.

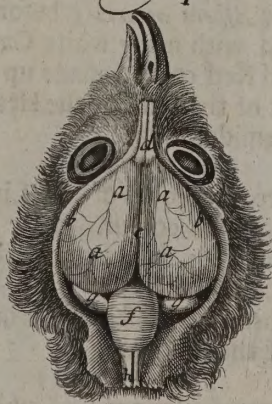
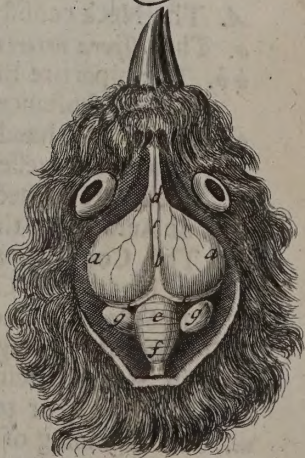


Fig. 5.



Tab. LIX. Fig. 1. *The Head of a Kings-Fisher opened.*

THE Brain of a Kings-fisher seemeth to be beautified with diverse Prominencies of different shapes and sizes, and some of them seem to be pyramidal.

- + a a. The Hemisphaeres + in this Bird as well as others begin in points, and end in more enlarged dimensions.
- + b b. The olfactory Nerves seem to be double, the more outward + take their Origin from the sides of the *Medulla oblongata*, and creep under the Brain, a little space from its Origination.
- + c c. The inward olfactory Nerves + borrow their rise from the *Medulla oblongata*, and creep under the Origins of the Hemisphaeres, and pass along toward the Beak.
- + d. The *Cerebellum* + in this Bird is endued with a kind of inverted pyramidal Figure, by reason its Base is upward, and its Cone downward.

Fig. 2. *The Head of a Goose divested of its Coats.*

This Figure of the Goose is much different from the former, in which the Brain of the Goose is divested of its Coats, and appeareth to be a *Système* of many Globules + (besetting each Hemisphaere) composed of several kinds of vessels; so that they have much affinity with Glands, as being strainers of the Blood, whereby the Albuminous part of the Blood is separated from the Red Crassament, in order to the preparation of the nervous Liquor.

- + b b. The Hemisphaeres + begin in Apices, or points, and end in much greater rounded heads, and between passeth a Fissure + separating the Hemisphaeres from each other.
- + c c. Beyond the Apices of the Hemisphaeres, is seated the *Os spongiosum* +, adorned with a Conical Figure.
- + e e. The optick Nerves + take their rise near the Origin of the *Medulla oblongata*, and are inserted into the inward region of the Eyes.
- + f f. The olfactory Nerves + sprout out of the sides of the *Medulla oblongata*, and afterward pass over the optick Nerves, and encircle the *Os spongiosum* with Arches, and then associate, and out of their
- + g g. Trunks arise on each side a branch +, and terminate near the perforation of the Bill. These
- + h h. Trunks of olfactory Nerves end in two round protuberancies +, out of which do arise many nervous Fibres + terminating near the extremity of the Bill.
- + i i. Near the posterior region of the Brain is seated the *Cerebellum* +, adorned with an Oval Figure,
- + k. and beset with many oblong narrow Processes, somewhat like Parallelograms in shape.

Fig. 3. *The Head of an Owl opened.*

- a a. The *Dura mater*, endued with many branches of Blood-vessels.
The Brain consisteth of four Processes.
- b b. The two anterior are beautified with an Oval Figure.
- c c. The two posterior are adorned with a Semilunary Shape.
- d. The *Cerebellum* seated beyond the posterior Processes of the Brain, dressed with many Blood-vessels.

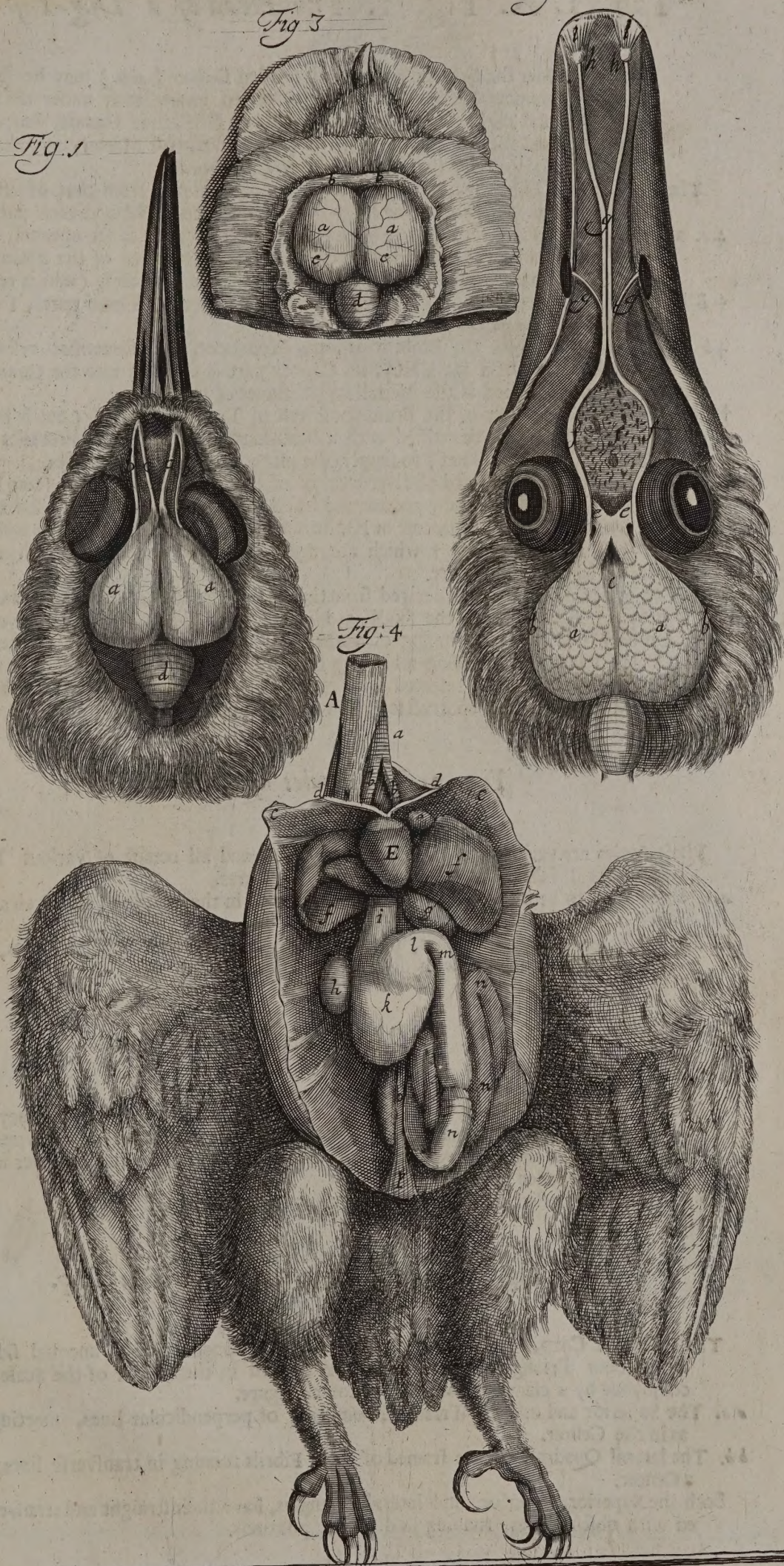
Fig. 4. *The Body of an Owl opened.*

- A. The Neck consisting of many small muscular Fibres.
- a. The *Aspera arteria* consisting of many annular Cartilages,
- b b. The bipartite Branches of the *Aspera arteria* (before it is divaricated into the Lungs) seeming to be a Red substance, interspersed with many white Cartilages.
- c c. The Lungs hued with a florid Red colour, made up of many vesicles of Air.
- d d. The Blood-vessels coming out of the Base of the Heart.
- E. The Heart endued with a pyramidal Figure.
- e. The Auricle of the Heart.
- f f. The Concave parts relating to the Lobes of the Liver.
- g. The Bladder of Gall being of a bluish colour.
- h. The Spleen clothed with a bright Red, and seated in the Left side, not far from the side of the Stomach.
- i. The Gullet, passing under the Liver
- k. The Stomach being of a membranous substance, as in Carnivorous Birds, Hawks, &c.
- l. The *Pylorus*, or termination of the Stomach.
- m. The beginning of the Guts.
- n n. The Guts (having many circumvolutions) of which the first is the greatest.
- o. The *Intestinum rectum* going in a straight line.
- p. The *Closca*, into which the Guts discharge their Excrements.

Fig: 2:

Fig: 3

Fig: 1



Tab. L X. Fig. 1. *The Head of a Dog-Fish opened.*

- U**nder the Skull of a Dog-fish (called *Galeus Lævis*) may be seen three sorts of clammy Liquor, The First is lodged immediately under the Skull, being thick and highly viscid; The Second is a Crystalline Humor, seated in the middle; and the Third Liquor is a most glutinous gross Matter, immediately covering the Coats of the *Cerebrum*, *Cerebellum*, and *Medulla spinalis*.
- The Brain of this Fish is very remarkable, and very different from that of other Fish, as being made of three Apartments, or large Processes, which consist of diverse parts, The First is
- + *a*. adorned with a Semilunary Figure +, whose Convex Surface is set upward, and the Concave below, encircling the upper region of the middle Province of the Brain. To the Horns of the Semilunary Prominence, are affixed two other Processes, (which resemble Legs) to
 - + *B B*. which are appended two Processes, not unlike Feet +. These parts, I conceive, are the *Thalami nervorum opticorum*.
 - + *b b*. The middle story of the Brain + is very Prominent, and somewhat resembleth in plumpness, the Breast of a fat Child; its Convex part is received into the Concave bosom of the upper Province, and is the Medullary substance of the Brain.
 - + *C C*. The Third Province of the Brain consisteth of Two Processes + (much less then the other) and each of them is beautified with a Semi-lunary Figure; these Processes are instituted by Nature (as I apprehend) to supply the place of Natiform Processes.
- The *Cerebellum* is composed of diverse ranks of Processes, a middle, and two lateral ones: The
- + *c*. middle + is made up of many greater and less Semi-lunary Processes, enclosed above in the Concave Surface of the Testiforme or Natiform Processes; and below to the inward rowe of late-
 - + *d d*. ral + *e e*. small Processes + which are again immured on each side with greater Processes +, graced with an Oval Figure.
 - + *f f*. The optick Nerves + are derived from the sides of the *Medulla oblongata*, and passing through proper perforations of the Skull, are inserted into the inside of the Eyes.
 - + *g g*. On each side of the beginning of the *Medulla Spinalis* proceedeth a Nerve + covered with a Black Tunicle, and passing all along the outside of the Skull, over the upper part of the
 - + *h h*. Eye, after an Inch, is inserted with many Fibrils + into the upper Mandible, and assisteth its Muscles in their contraction, by which it is lifted up.

Fig. 2. *The Scales of a Gar-Fish.*

- These Scales are various in Magnitude and Figure, and all consist of various Triangles, dressed with several Fibrils, running in variety of postures.
- + *a a*. Some seem to be of an Octangular Figure, seated in the middle of the Scales, and are beautified with different Fibrils.
 - + *b b b b*. Scales resembling Lozanges, placed on each side of the Octangular Scales, which consist of various Figures, dressed with diverse Triangles.

Fig. 3. *Of the Scales of a Carpe.*

- The situation of the Scales of a Carp, and other Fish is very curious, as they are placed one over another, after the manner of Tiles or Slates, and at last inserted into the Skin.
- + *a a a a*. The Figure of these Scales seemeth to resemble Scolops, as being narrower in the upper region, and broader in the lower.
 - + *b b b b*. They are dressed with many Filaments, passing downward in length.

Fig. 4. *Representing one Scale of a Carp.*

- The Scale of a Carp, as well as other Fish, is a Quadrangle made of unequal sides, and composed of Four Triangles, whose points are united in the Center of the Scale, where they are conjoined by a clammy Matter of a Conick Figure.
- + *a a*. The Superior and Inferior Triangle, consisting of perpendicular lines, meeting in the middle as in the Center.
 - + *b b*. The lateral Quadrangles are framed of many Fibrils running in transverse lines, and meet all in a Center.
- Both the Superior, Inferior, and lateral Triangles, have their straight and transverse lines, covered with obscure lines, running in different positions.

Fig. 1.



Fig. 3.

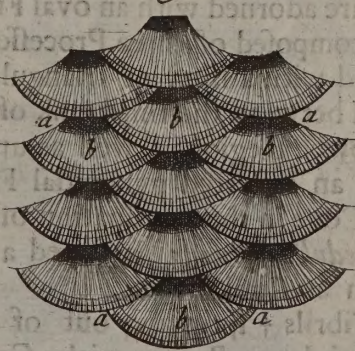


Fig. 2.

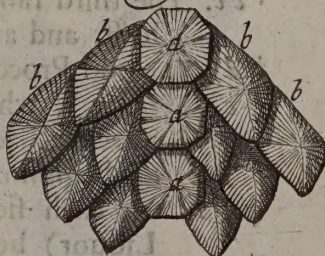


Fig. 4.



The lower Region of the Brain of a Skin beneath to be composed of three ranks of
Processes, and an odd one.
The first rank consists of two pair of Prominences, ended with a kind of
pyramidal Figure.
The second rank are made up of Processes, of which the middle one is Or-
bicular, and the lateral are adorned with an oval Figure.
The third rank are also composed of Processes, of which the middle is the
largest, and are all adorned with a fan-shaped Figure.
The fine Systems of Nerves of the Trunk of the Olfactory
Nerve, are ended in their lower Region with a Convex, and in their upper with
a Convex Surface.
The inside of the Fibres springing out of the Trunk of the Olfactory Nerve.

Tab. LXI. Fig. 1. *The upper Region of the Brain of a Skait taken out of the Skull.*

THe Brain of a Skait being taken out of the Skull, a *Bel visto*, appears composed of many ranks of Processes, to which are appendant (as outlets) the Optick and Olfactory Nerves.

The Brain and *Cerebellum* is framed of five rows of Protuberances, the first is made of
 † *a a.* four Processes, two lateral, and two interior; the out-ward † are graced with a kind of pyramidal Figure, the Bases adjoining to the middle Processes, and the Cones to the Olfactory Nerves.

† *b b.* The middle pair † are greater and longer then the lateral, and somewhat resemble Parallelograms.

† *c c.* The second row † are endued with an oval Figure, and are much less then the first.

† *d d.* The third rank † are after a manner adorned with a pyramidal shape.

† *e e.* The fourth row † are somewhat of a triangular Figure.

† *f f.* The fifth row † make the *Cerebellum*, and have an oblong irregular Figure, as well as the rest of the Processes.

And each side of the Processes of the *Cerebellum* is encircled with Processes of irregular shapes, not unlike Intestines, and somewhat resembling the *Anfractus* of a Humane Brain.

† *g g.* Beyond the *Cerebellum* appears the *Medulla Spinalis* † divided into two equal parts

† *h h.* by the interposition of a small Fissure † and each side of the *Medulla Spinalis* is

† *iiiiiii.* garnished with numerous Nerves † deriving themselves from its inward Recesses.

† *k k.* The Optick Nerves † take their rise from the *Medulla oblongata*, and afterward creep out of the Brain, and after some space are inserted into the Eyes.

† *l l.* The Olfactory Nerves are two pair, of which the least † seem to spring out of the second row of Processes (endued with an oval Figure) and after some space, are inserted into the greater Trunk of the first pair of Olfactory Nerves.

† *m m.* The greater pair of Olfactory Nerves † do sprout out of the Apices of the first rank of Processes, and after an Inch or more, are branched obliquely on each

† *n n n.* side into the numerous Fibrils † making a fine System, the immediate Organ of Smelling.

Fig. 2. *The lower Region of the Brain of a Skait.*

The lower Region of the Brain of a Skait seemeth to be composed of three ranks of Processes, and an odd one.

† *a a.* The first rank † consist of two pair of Protuberances, endued with a kind of pyramidal Figure.

† *b b.* The second rank † are made up of three Processes, of which the middle one is Orbicular, and the lateral are adorned with an oval Figure.

† *c c.* The third rank † are also composed of three Processes, of which the middle is the least, and are all adorned with a kind of triangular shape.

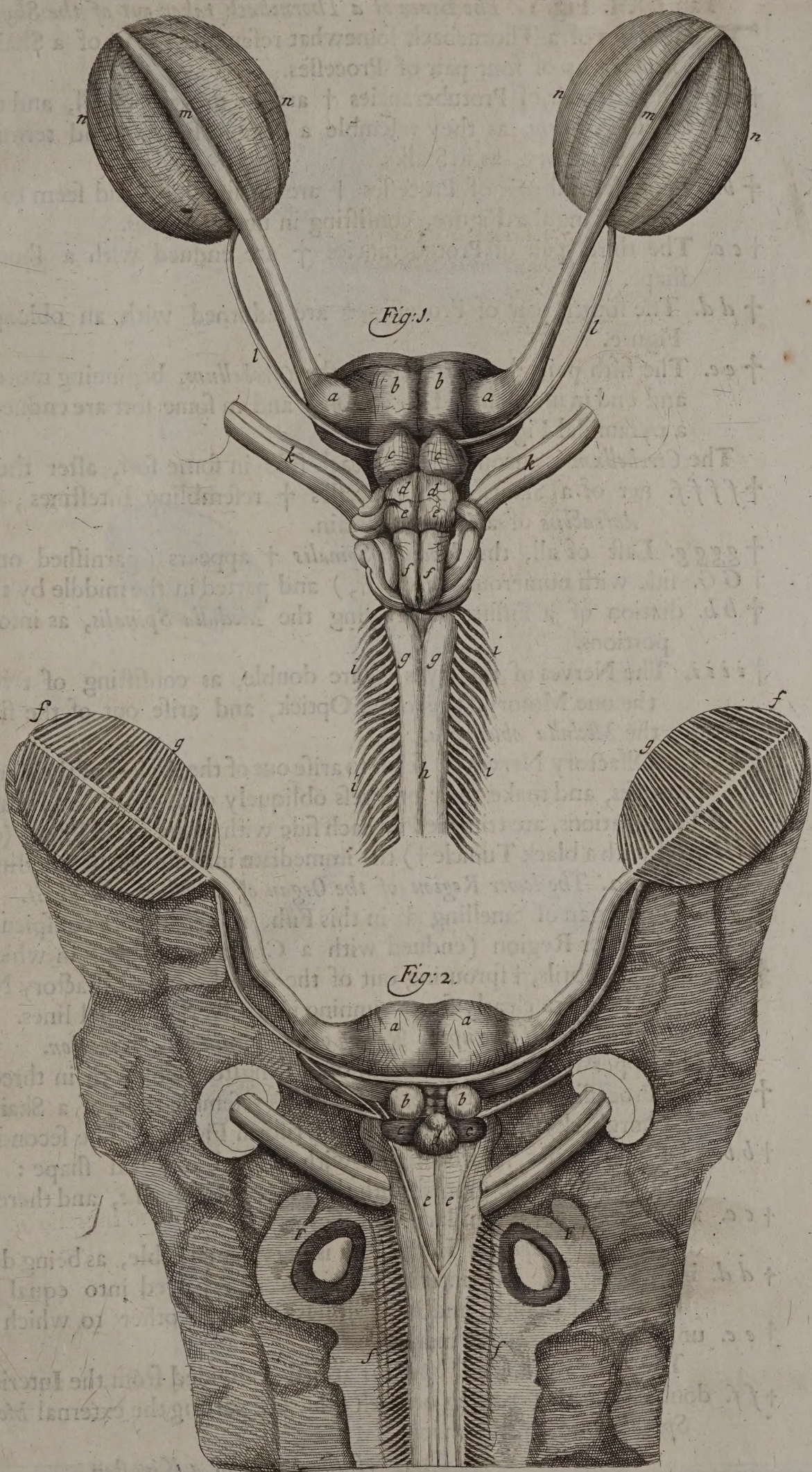
† *d.* The odd Process † is seated between the third rank of the Processes, and the *Cere-*

† *e e.* *bellum* †, which in its lower Region as well as upper, is parted into two equal portions, adorned with an inverted pyramidal Figure, whose Base is seated in the beginning, and its Cone in the termination of the *Cerebellum*.

† *F F.* On each side of the *Medulla Spinalis*, is seated a Cavity, † (full of Cristalline Liquor) beautified with an Oval shape.

† *f f f f.* The fine Systems of Fibrils † springing out of the Trunks of the Olfactory Nerves, are endued in their lower Region with a Concave, and in their upper with a Convex Surface.

g g. The inside of the Fibrils springing out of the Trunks of the Olfactory Nerves.



Tab. LXII. Fig. 1. *The Brain of a Thorneback taken out of the Skull.*

THe Brain of a Thorneback somewhat resembleth that of a Skait, and is made up of four pair of Processes.

† *a a.* The first pair of Protuberancies † are the greatest of all, and may be called *Pyriform*, as they resemble a Pear in Figure, and terminating in the Olfactory, as in Stalks.

† *b b.* The second pair of Processes † are the smallest, and seem to resemble a triangular Figure, consisting in unequal sides.

† *c c.* The third pair of Protuberancies † are endued with a short oval shape.

† *d d.* The fourth pair of Processes † are adorned with an oblong oval Figure.

† *e e.* The fifth pair † belonging to the *Cerebellum*, beginning more large, and end in more small Dimensions, and in some sort are endued with a pyramidal Figure.

The *Cerebellum* is encompassed on each side in some sort, after the manner of a Skait, with Processes † resembling Intestines, or the *Anfractus* of a Humane Brain.

† *g g g g.* Last of all, the *Medulla Spinalis* † appears (garnished on each side with numerous Nerves †,) and parted in the middle by the mediation of a Fissure † dividing the *Medulla Spinalis*, as into equal portions.

† *i i i i.* The Nerves of the Eyes † are double, as consisting of two pair, the one Motory, the other Optick, and arise out of the sides of the *Medulla oblongata*.

† *k k.* The Olfactory Nerves † seem to arise out of the Apices of the *Pyriform* Processes, and make their progress obliquely cross-ways; and near their Terminations, are trimmed on each side with many small Fibres (covered with a black Tunicle †) the immediate instrument of Smelling.

Fig. 2. *The lower Region of the Organ of Smelling in a Skait.*

† *a a.* The Organ of Smelling † in this Fish, is much more conspicuous in the lower Region (endued with a Concave Surface) in which the

† *b b.* nervous Fibrils, † sprouting out of the Trunk of the Olfactory Nerves may be more clearly seen, running in transverse parallel lines.

Fig. 3. *Of the upper Region of the Brain of a Kingston.*

The upper Region of the Brain of a Kingston consisteth in three pair of Processes; The first pair † (much resemble those of a Skait and Thorneback) as adorned with a *Pyriform* Figure: The second pair

† *b b.* of Prominencies †, are dressed with a kind of Oval shape: The third pair are graced with the Figure of *Mamillæ*, and thereupon

† *c c.* may be called Mammillary Processes †.

The *Medulla Spinalis* in this Fish is very remarkable, as being double in its Origin. The interior or middle † is parted into equal parts

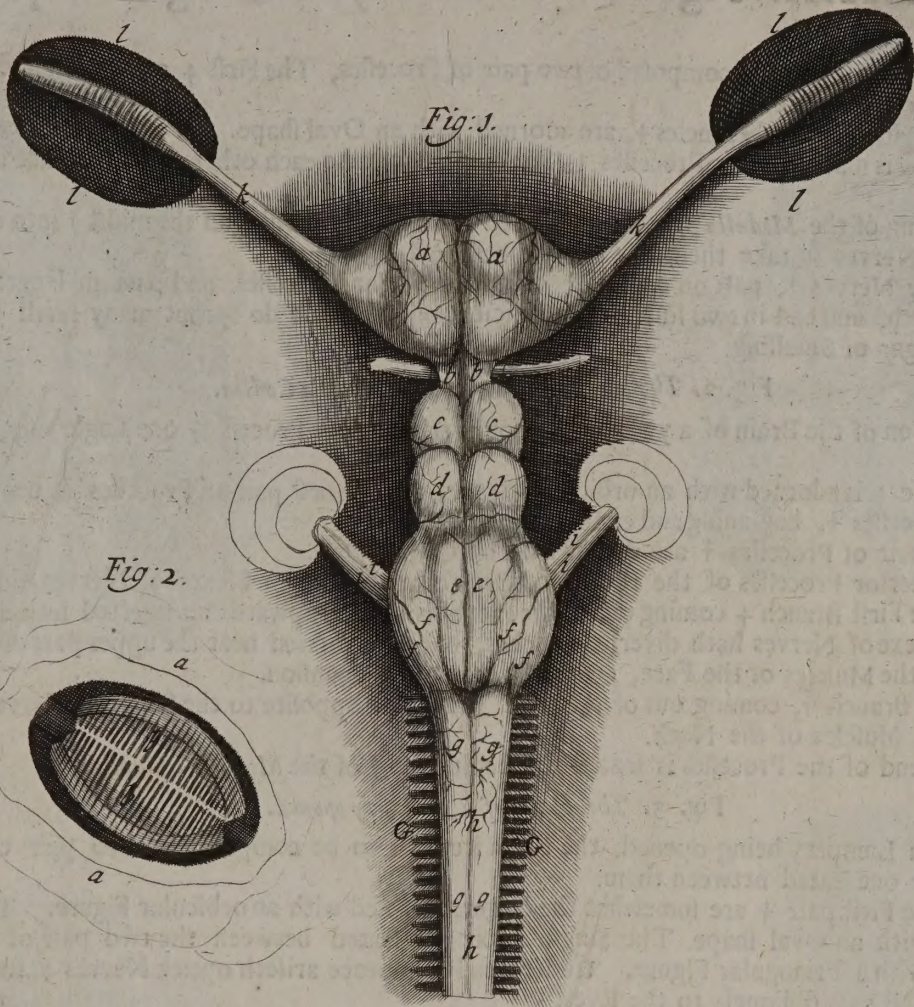
† *d d.* by a small Fissure, and is much less then the other to which it is

† *e e.* united after an Inch or more.

The outward *Medulla Spinalis* at first is divided from the Interior by a double Fissure † passing on each side, and parting the external *Medulla Spinalis* into equal portions.

Fig. 4. *The lower Region of the Brain of a Kingston.*

The lower Region of the Brain of a Kingston is very like to the upper, in number, shape, and size of Processes, which is very rare in other Fish.



Tab. LXIII. Fig. 1. *The Head of a young Cod opened.*

- a a.* THE Brain of a Cod is composed of two pair of Processes, The First + and the least, are beautified with an orbicular Figure.
- + b b.* The Second pair of Protuberancies +, are adorned with an Oval shape.
- + c c.* The *Cerebellum* is made of two Processes +, standing opposite to each other, and are graced with a pyramidal Figure.
- + d d.* The beginning of the *Medulla Spinalis* + is parted by a Fissure (running in the midst) into equal portions.
- + e e.* The optick Nerves + take their rise from the *Medulla oblongata*.
- + f f.* The olfactory Nerves +, pass on each side of the orbicular Processes, and pass in length till they arrive near the Mouth, and end in two small Prominencies, out of which do sprout many small Fibrils + the immediate Organ of Smelling.
- + g g.*

Fig. 2. *The lower region of the Brain of a Codlin.*

The lower region of the Brain of a young Cod consisteth of five Processes, one single one, and two pair of Processes.

- + a.* The single one + is adorned with an orbicular Figure, and the first pair of Processes is beautified with small pointed Processes +, beginning and ending in acute Cones.
- + b b.* The Second pair of Processes + are dressed with an Oval Figure.
- Above the Inferior Processes of the Brain do offer themselves seven Plexes of Nerves, dispensed with many parts. The First Branch + coming out of the Plexe, is carried upward and inserted into the Eyes.
- + d d.* The next Plexe of Nerves hath diverse Branches, one + is carried near the upper part of the Mouth. And
- + e e.* others + to the Muscles of the Face, ending in a broad Expansion.
- + f f.* The Third Branch +, coming out of the same Trunk, is opposite to the Smelling Nerves, and is implanted into the Muscles of the Neck.
- + g g.*
- + b.* At the lower end of the Processes is seated the beginning + of the *Medulla Spinalis*.

Fig. 3. *The Head of a Lamprey opened.*

The Head of a Lamprey being opened, the Brain seemeth to be composed of two pair of Protuberancies, and a single one seated between them.

- + a a a.* *+ c c.* The First pair + are somewhat the larger, adorned with an orbicular Figure. The Second pair + are endued with an Oval shape. The Single Process + seated between the two pair of Protuberancies, is beautified with a Triangular Figure. Under this Prominence ariseth optick Nerves + from the *Medulla oblongata*, and pass obliquely to the Eyes.
- + d d.* Below the Second pair of Processes, the *Medulla Spinalis* + seemeth to take its Origen.
- + e e.* Above the First pair, (being orbicular Protuberancies) are seated two round Cavities + parted from each other, and encircled with white Membranes.
- + f f.* Above these Cavities appeareth a white Membrane, beset with many long narrow streaks +, like so many Rays, and are nervous Filaments, of somewhat a more dark colour then the Membranes.
- + g g.*
- + E.* The Olfactory Nerves doth terminate into many Filaments + (running crossways, which are the Organ of Smelling.

Fig. 4. *The many rows of Teeth besetting the Mouth of a Lamprey.*

- + a a a a a.* The Mouth of a Lamprey is garnished with many ranks of pointed Teeth + (running in Circles, and Semi-circles) somewhat resembling the Teeth of a Sawe in Figure.
- + b.* Some of the Teeth are covered with a Case + furnished with many holes, adapted to the Teeth in shape and size.

Fig. 5. *The Head of a Trout opened.*

The Brain of a Trout is composed of two pair of Processes, and the last being single, maketh the *Cerebellum*.

- + a a.* The First pair of Protuberancies + are very much the smaller, beautified with an orbicular Figure.
- + b b.* The Second pair + are endued with an oblong Oval shape, adjoining below to the *Cerebellum*, and above the Orbicular Processes.
- + c.* The lowermost Process + is beautified with a Triangular Figure, which is the *Cerebellum*.
- + d.* Below this Process appeareth the Origen of the *Medulla Spinalis* + parted into equal parts by the interposition of a Fissure,
- + e e.* The optick Nerves + seem to arise under the orbicular Processes, and are derived from the *Medulla oblongata*, and pass crossways, and are inserted into the inside of the Eyes.
- + f f.* The Olfactory Nerves + also seem to creep under the Orbicular Protuberancies, and take their rise from the *Medulla oblongata*.

Fig. 6. *The Head of an Umber opened.*

The Brain of an Umber much resembleth that of a Trout in the Number and Figure of Processes, only the *Cerebellum* differeth, as being adorned with a kind of orbicular shape.

- + a a.* *+ b b.* The First pair + of Processes are decked with an Orbicular Figure; and the Second pair + with an oblong Oval shape. And the *Cerebellum* + is beautified with an Orbicular Figure.
- + c.* A little below, as it were coming out, of this Process, may be discerned, the Origen of the *Medulla Spinalis* + divided into equal portions by a Fissure.
- + d.*
- + e e.* The Optick Nerves + seem to sprout out of the oblong Oval Processes, and take their course obliquely toward the inside of the Eyes.
- + f f.* The Olfactory Nerves + seem to arise out of the Orbicular Processes, and take their Progress in straight lines, toward the Mouth.

Fig. 1.

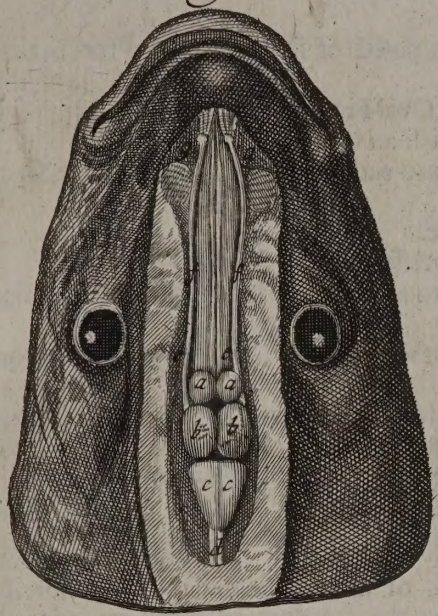


Fig. 2.

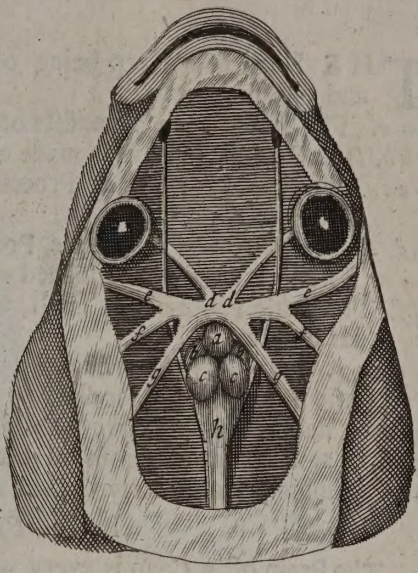


Fig. 3.

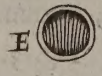
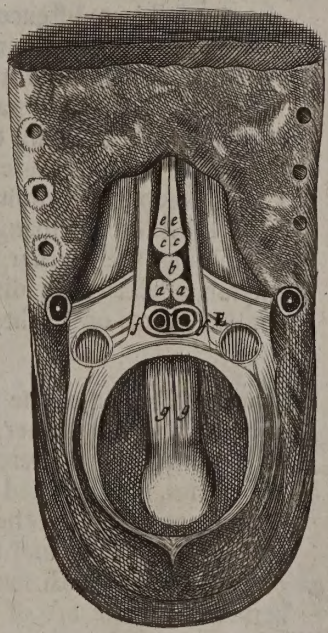


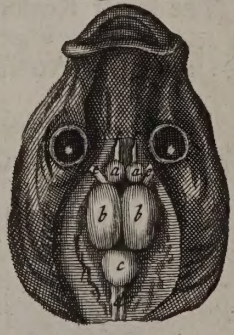
Fig. 4.



Fig. 5.



Fig. 6.



Tab. LXIV. Fig. 1. *The Head of a Carp opened,*

THE Head of a Carp being opened, the Brain seemeth to be composed of five ranks of Protuberancies, and one single one.

- + a a. The First rowe + consists only in two Processes, dressed with an Oval Figure.
- + b b. The Second rank + is made up of four Prominencies, trimmed with an orbicular shape.
- + c c. The Third rowe + of Processes are bigger then the former, and are endued with an Oval Figure, standing obliquely.
- + d. The fourth + is One single Process, dressed with an irregular shape.
- + e e. The fifth rank + is adorned with a kind of Oval, or pointed Processes.
- + f. The single Process + is small, and seated between the last Protuberancies, and is beautified with a Triangular Figure.
- + g g g. The Nerves of the Eyes + are double the one Optick, the other Motory, and seem to arise out of the first pair of Processes.
- + h h. The Olfactory Nerves + begin in knots, and are carried close for some space, and afterward do part, and
- + i i. near their terminations have two orbicular Prominencies + and are at last branched into many Filaments,
- + k k. running transversely (after the manner of a Scolop-shell) the immediate Organ of Smelling,

Fig. 2. *Of the transparent substance, encircling the Brain of a Carp.*

The Brain of a Carp is every way above and belowe, and laterally immured with a transparent clammy + a a a. Liquor, bestudded with an innumerable company of specks +, or minute Globules of a yellowish colour, somewhat resembling the Lytharge of Gold; And here I beg the freedom to speak my conjecture, about the first production of this viscid Matter, whence its Transparency proceedeth, and as such it clearly bespeaketh its Conception and Nativity, as the progeny of the more clammy part of the Seminal Liquor, receptive of Concretions caused by Saline Particles; so that this substance, *In solutis principiis* in its primitive Nature, being beautified with Transparency, may well retain it, when coagulated into a more solid consistence; and being formerly fluid, as Seminal Liquor hath its constituent part, aranged in such orderly positions, fitted to receive Transparency, by reason it being formerly a fluide Body, during which time it was easy for the subtle and bright Rays of Light to pass through the regular Pores, and make themselves passages every way, and afterward so to dispose the more minute Particles, when consolidated, to retain the same Pores through which the beams of Light were transmitted, when it had the more loose Nature of a liquid Form, which afterward growing more solid with the same passages of Light, keep the primitive Constitution of a Transparent Body, when metamorphosed into a more solid substance, bespangled with a numerous train of little specks, or Globules (of a yellowish colour, resembling the Lytharge of Gold) produced of the more dense and opaque Particles of the Seminal Liquor, affected with disorderly Pores (not answering those of the transparent substance) which do shut out the beams of Light, transmitted through the more regular passages of the other Transparent Body.

Fig. 3. *The upper Region of the Brain of a Carp.*

The upper Region of the Brain of a Carp is here added, by reason I found it (upon Dissection) much different from the former. In this Brain I discovered a great *Lusus natura* (as oftentimes in other Fish) + a a a a a. which hath numerous Prominencies + sporting themselves in various Shapes, Magnitudes, and irregular + b b. Situations, interspersed with Processes, running in pleasant Meanders +. These different Protuberancies do not answer each other in rank, but seem to be confused, as not seated one against another, as in regular Brains of Fish, and the Processes are not of the same Figure, which is only found in the first pair of Processes + c c. endued with somewhat of an orbicular Figure, and small, if compared with diverse other Protuberancies; some are of the same shape, and much greater, but not seated in pairs, opposite to each other, but in confused positions. Other Processes seem to resemble Semi-circles in Figure; And the Posterior prominencies are the greatest; and the most minute are seated for the most part, on the margin of the Brain; so that in fine, this Systeme of various Processes (relating to the Brain of a Carp) doth seem to resemble a bunch of Grapes, of greater and less size, confusedly growing to the stalk.

Fig. 4. *Of the lower Region of the Brain of a Carp.*

The lower Region of the Brain of a Carp, is garnished with eight Processes of several Magnitudes. The First + a a. pair + are somewhat small, endued with an Oval Figure, and coated with a Red colour. The Prominencies + b b. (confusedly placed between the first and last pair) are four in number, small in size, and orbicular in Figure.

The Posterior pair of Processes are much the greatest, as seated near the *Medulla Spinalis*, and are hued + c c. + d. with a Red colour, and of an Oval Figure. The *Medulla Spinalis* + parted in the middle by a Fissure.

For the most part, the Processes besetting the *Medulla oblongata* both above and below, are Red, and inclining somewhat to a cineritious colour, as being cortical. And there are three Prominencies, which are White, as being chiefly made of a Medullary substance.

Fig. 5. *The Head of a Rochet opened.*

- + a a. The Brain of a Rochet, consisteth of two pair of Processes, The First pair + are much less in size then the
- + b b. other, and are beautified with an orbicular Figure; The Second pair + of Protuberancies are adorned with an Oval Figure.
- + c c. The last pair of Processes + make the *Cerebellum*, and are endued with a kind of inverted pyramidal Figure, having their Bases above, and Cones below, toward the *Medulla Spinalis*.
- + d. The beginning of the *Medulla Spinalis* + as also its farther progress, is divided into two equal portions, by the interposition of a Fissure.

Fig. 1.



Fig. 2.

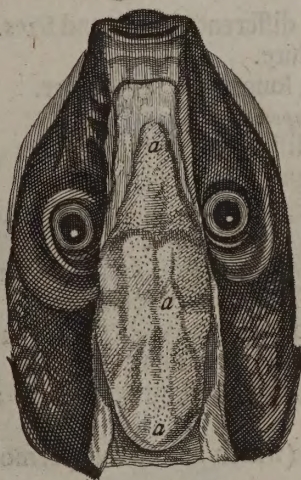


Fig. 3.



Fig. 4.



Fig. 5.



And I have observed in the Brain of Fish, that their lower Region hath less Procces than the upper, which I have seen in many Dissections. & The Medulla Spinalis (as in other Fish) is parted by a Filure.

Tab. LXV. Fig. 1. *The Head of a Prill opened.*

THe Brain of a Prill is irregular, as the Processes of one side do not answer the other, either in figure, magnitude, or number.

- + a. The right side of the Brain of this Fish is composed of two Prominencies, the first + is minute and orbicular.
- + b. The second Protuberance + is much greater, and beautified with an Oval figure.
- + c. The left side is composed of a double number, of four Processes; The two first + are seated in the Van, and are adorned with a small Orbicular figure.
- + d. The third Process + of the left side is much more enlarged; and dressed with an Oval figure.
- + e. The fourth + of this side is endued with an Oblong figure somewhat resembling an Oval shape.
- + f f. The Optick Nerves + are of unequal length.

Fig. 2. *The Head of a Place opened.*

The Brain of a Place is also irregular, as being confused in the situation, shape, size, and number of its Protuberances.

- + a. The first row of Processes are two in number +, and seem to be endued with a minute Orbicular figure.
- + b. The second row + seem to be three in number, (of which the largest are seated in the middle) adorned with an Oval shape.
- + c. In the close of the Prominencies, is seated a single Prominence + on the right side of the *Medulla Spinalis*, and is (as I conceive) the *Cerebellum*, which is very minute in this Fish.
- + d. The Olfactory Nerves + do creep under the anterior Processes, and take their progress toward the Mouth in straight lines.
- + e e. The Optick Nerves + are different in length; The Right being shorter then the Left.

Fig. 3. *The Head of a Dabbe opened.*

The Brain of a Dabbe is disorderly in figure, size, and number of its Processes.

- + a. The first Process + is single standing toward the right side of the Brain.
- + b. The second Processes + are seated directly opposite to each other, the middle Prominence is adorned with a round shape.
- + c. The other Protuberancies of this row +, are seated on each side of the middle Prominency, and are adorned with a kind of Oval figure.
- + d. The posterior Processes + are many, seated in a Cluster, of different shapes and sizes.
- + e. The *Medulla Spinalis* + is divided into equal parts by a Fissure.
- + f f. The Optick Nerves + are various in length, the left being longer then the other.

Fig. 4. *The Head of a Flounder opened.*

The Brain of a Flounder is composed of various Processes of different shapes and sizes; The three

- + a. first + run in length in a kind of Line, and have various figures and magnitudes.
- + b. The next Protuberancies + are also three in number seated in a row, and are beautified with an Orbicular figure.
- + c. The posterior rank of Prominencies + seem to be endued with an Oval figure, the middle only appeareth fair, shading the other, making them to represent a Semicircular figure.
- + d. The last Prominency + is single, placed on the right side of the *Medulla Spinalis*, and seemeth to be adorned with an Orbicular shape, and is the *Cerebellum* in this Fish.
- + e e. The *Medulla Spinalis* + near its Origen hath larger dimensions, and groweth less and less, of a Pyramidal figure.
- + f f. The Nerves of the Eyes are two pair, one being Optick + (which are the uppermost) and the left is longer then the right.
- + g g. The other pair are Motory +, and exceed the other in greatnels.
- + h. The Olfactory Nerves + creep under the minute first Processes, and pass toward the Mouth in a
- + i i. straight progress, and end in Fibres.

Fig. 5. *The Head of a Soale opened.*

- + a a. The Brain of a Soale hath divers Processes + seated in the Origen of the Brain, and are endued with several figures and magnitudes, and grow less in size, as they approach the Mouth.
- + b b. After the anterior Processes follow a pair + larger then the former, endued with an Oval figure.
- + c. The posterior Process is single + (seated on the right side of the *Medulla Spinalis*) adorned with an Orbicular shape.
- + d d. The *Medulla Spinalis* + is parted by a Fissure running in the midst.
- + e e. The Optick Nerves +, as in many other flat Fish, are endued with an unequal length.
- + f f. The Olfactory Nerves + creep out of the Brain under the cluster of anterior Processes, and go in a straight course.

Fig. 6. *The Head of a Turbat opened.*

The Brain of a Turbat is very regular in the situation, size, and figure of its Processes.

- + a a. The first rank of the upper Region + are two in number, dressed with an Orbicular shape.
- + b b b. The second row + consists in three Prominencies (beautified with an Oval figure) of which the biggest are seated in the middle.
- + c. The posterior Process +, is somewhat of a Triangular figure, and is the *Cerebellum*.
- + d d. The Optick Nerves + are of a different length, and the right exceedeth the other in dimensions.
- + e e. The Olfactory Nerves + do arise under the first pair of Processes, and take their course in straight lines.

The lower Region relating to the Brain of this delicate Fish, is furnished only with three short oval Protuberancies.

And I have observed in the Brains of Fish, that their lower Region hath less Processes then the upper, which I have seen in many Dissections.

- + f. The *Medulla Spinalis* + (as in other Fish) is parted by a Fissure.

Fig. 1.



Fig 2



Fig. 3.



Fig. 4

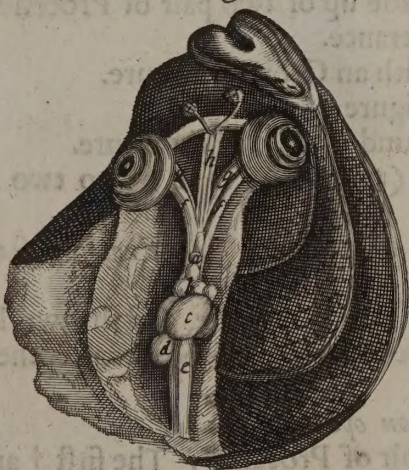


Fig. 5.

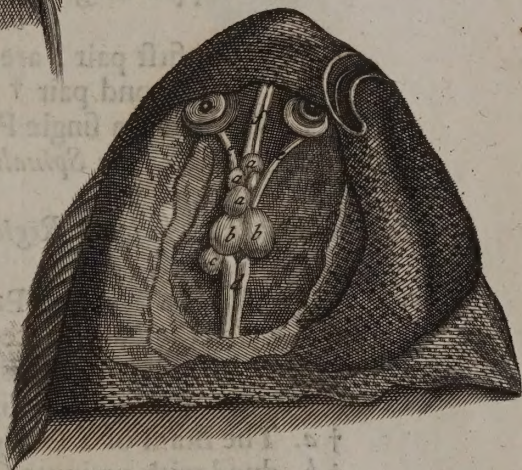


Fig. 6.



Tab. LXVI. Fig. 1. *The Head of a Whiting opened.*

The upper Region of the Brain of a Whiting is formed of six Processes of different shapes and sizes.

- + a a. **T**He first pair of Protuberancies +, being the smallest of all, is adorned with an Orbicular figure.
- + b b. The second pair + being above double in magnitude, are beautified with an oblong Oval shape.
- + c c. The third pair of Processes + are adorned with an inverted Pyramidal figure, as their Bases are above and the Cones below; and do constitute the *Cerebellum*, divided in the middle by a Fissure.
- + d d. Below may be seen the *Medulla Spinalis* + out of whose beginning on each side
- + e e. of it, doth arise a Nerve +, which climbing up, doth encircle the Processes of the *Cerebellum* and Brain, and afterward intersect the Optick Nerves, and passing all along the Head, do intersect each other, and at last terminate into Arches.
- + f f. The Optick Nerves + do creep out of the Brain under the Orbicular Processes, and pass obliquely into the inside of the Eyes.
- + g g. The Olfactory Nerves + creep out of the Brain under the Orbicular Processes, and do associate for some space, and afterward part and are at last implanted with va-
- + h h. rious Fibrils into the Organs of Smelling +.

Fig. 2. *The lower Region of the Brain of a Whiting, consisteth of a row of five Processes, and the most minute is seated in the middle + dressed with a Globular figure.*

- + a. The inward adjacent Processes + are trimmed with an Oval shape.
- + b b. The outward Protuberancies seem to be pointed +, beginning in acute and ending in obtuse Cones.

Fig. 3. *The Head of a Pearch opened.*

The upper Region of the Brain of a Pearch is made up of two pair of Processes, and of a single Protuberance.

- + a a. The first pair + are the smallest, and decked with an Orbicular figure.
- + b b. The second pair + are adorned with an Oval figure.
- + c. The last is a single Process +, beautified with a kind of Triangular figure.
- + d. The *Medulla Spinalis* + is parted in the middle (as in other Fish) into two equal parts.

Fig. 4. *The lower Region of the Brain of a Pearch is endued with four Processes seated in a rank.*

- + a a. The two middle Prominencies + are dressed with an Oval figure, and the two lateral
- + b b. (as they are placed by Nature) seem to enclose the middle Processes after the manner of Semicircles.

Fig. 5. *The Head of a Gudgeon opened.*

- + a. The Brain of a Gudgeon is composed of three pair of Processes: The first + are endued with a minute Orbicular figure; And the second pair + are somewhat larger, and are beautified also with the same figure.

The third are the largest, adorned with an Oval shape.

- + c c. + d. The two last are single + Processes +, placed one below another, the one great and the other small, and both Orbicular, and make the *Cerebellum*.
- + f f. The *Medulla Spinalis* + is disposed into equal parts by the mediation of a Fissure running in the middle.
- + e e. The Olfactory Nerves + arising under the minute pair of Globular Processes, make their progress toward the Mouth.

Fig. 6. *The Head of an Eel opened.*

The Brain of an Eel consisteth of two ranks of Processes, and a single Protuberance.

- + a. The first rank + hath three in number, dressed with a Globular figure.
- + b b. The second rank + hath two decked with an Oval.
- + c. The posterior Process + seemeth to be adorned with a quadrangular figure.
- + d d. The *Medulla Spinalis* + is little different from that of other Fish, as consisting of two parts, equally divided in the midst by a Fissure.
- + e e. The Optick Nerves + seem to be derived from each side of the lateral Orbicular Processes, seated in the first rank, and pass in an oblique transverse posture, and are inserted at last into the inside of the Eyes.

Fig. 1.



Fig. 2.

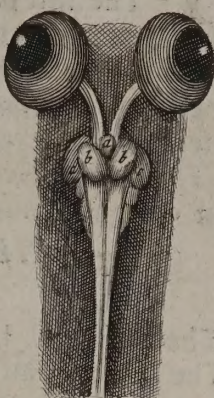


Fig. 3.



Fig. 4.



Fig. 5.



Fig. 6.



Tab. LXVII. Fig. 1. *The Head of a Dory opened.*

- The Brain of a Dory is composed of five Processes, endued with greater and less Ovals.
- † a a. The first pair † are the least, and are endued with a short Oval Figure
 - † b b. The Second † are much greater, adorned with an oblong Oval shape.
 - † c. The last Process † is Oval too, and is the *Cerebellum*.
 - † d d. The optick Nerves † seem to creep under the first pair of Oval Processes, and passing in an oblique transverse posture, are at last implanted into the inside of the Eyes.

Fig. 2. *The lower Region of the Brain of a Dory taken out of the Skull, is made up of five Processes as well as the upper.*

- † a a. The First pair † are orbicular.
- † b b. The Second pair † seem to be Conical, beginning and ending in Cones, and are adjacent to each side of the *Cerebellum*.
- † c c. The last Processes † divided in the middle by a Fissure, and conjoyned, do resemble a Triangle, and are the *Cerebellum*, which is sometimes one Process, and other times two, as in this Fish.

Fig. 3. *The Head of a Gurnet opened*

The Brain of a Gurnet is framed of nine Protuberancies, somewhat like a cluster of Grapes.

- † a a. The First pair † seemed to be endued with an Oval Figure.
- † b b. The Second pair † are dressed with a kind of Triangular shape.
- † c c c. The Third rank of Processes † are three in number, the two lateral seem to be beautified with a kind of Semi-circular Figure, and the middle Process with a Triangular.
- † d d. The last pair of Processes † are the least, and are endued with an Oval Figure.
- † e e. The optick Nerves † creep under the first pair of Processes, and take their progress in a transverse posture, and are inserted into the inside of the Eyes.

Fig. 4. *The Head of a Smelt opened.*

The Brain of a Smelt is made up of Seven Protuberancies, consisting of three pair and an odd Process.

- † a. The First pair † are very small, and of an orbicular Figure
- † b b. The Second pair † are endued with an Oval Shape.
- † c c. The Third pair † are adorned with an Oval Figure.
- † d d. The Posterior Process † (being the *Cerebellum*) is beautified with a kind of Triangular shape.
- † e e. The optick Nerves † in this Fish seem to arise under the Second pair of Processes, and tend toward the inside of the Eyes obliquely crossways.
- † f f. The olfactory Nerves † do arise under the first pair of Processes, and climb upward toward the Mouth.
- † g g. The *Medulla Spinalis* † in this as in other Fish, is divided into equal parts, endued with a Pyramidal Figure.

Fig. 5. *The Head of a Pope opened.*

The Brain of a Pope consisteth of nine Processes, various in size and shape.

- † a a. The First rank † is two in number, and are very minute, and of a Conical Figure.
- † b b. The Second † rank is made up of two Processes which are very small.
- † c c. The Third rank † of Prominencies are the greatest of all, and are dressed with an Oval Figure.
- † d. The Posterior Process † (being the *Cerebellum*,) is also beautified with an Oval shape.
- † e. The *Medulla Spinalis* † passing under the Posterior Process, is dressed with an inverted pyramidal Figure.

Fig. 6. *The Head of an Herring opened.*

The Brain of a Herring is composed of nine Processes.

- † a a. The First rowe † are a pair of Processes, beautified with an orbicular Figure.
- † b b. The Second rank † are much larger then the former, and are adorned with an oblong Oval shape.
- † c. The last Process † is dressed with a triangular shape.
- † d. The *Medulla Spinalis* is much like that of other Fish in Figure, only it seemeth not to be divided into equal parts by a Fissure.

Fig. 1.

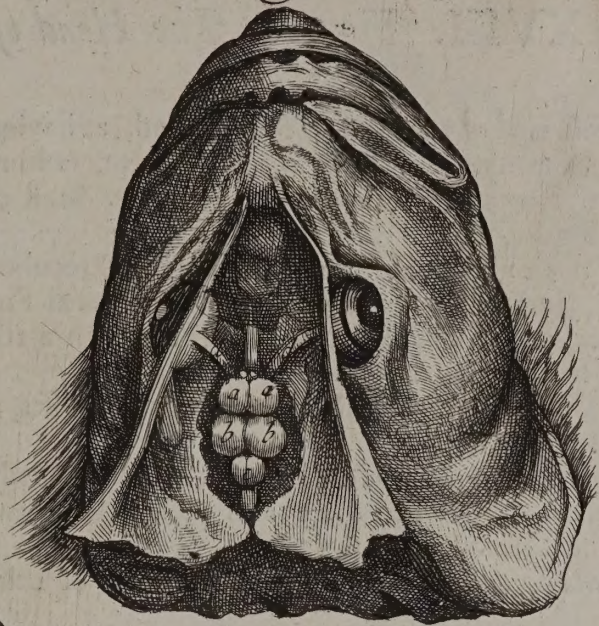


Fig. 3.



Fig. 2.



Fig. 4.



Fig. 5.



Fig. 6.



Tab. L XVIII. Fig. 1. *The Head of a Garfish opened.*

THis Fish is very remarkable for its Head, as having a long Process affixed to it, full of many Asperities, as so many Teeth, holding its Aliment when first seized. This oblong Process much resembleth the Beak of a Woodcock, Godvit, or Curlue in Figure.

- + The Brain of this Fish consisteth of four pair of Protuberancys. The First + are the most minute, and seem to be endued with a Conical Figure.
- + *bb.* The Second pair + appear to be adorned with a triangular shape, and do exceed the first in dimensions.
- + *cc.* The Third pair + are the largest of all the Processes, and are adorned with an oblong Oval Figure.
- + *dd.* The Fourth pair + are dressed with a kind of inverted Pyramidal Figur, by reason their Bases are placed upward, and their Cones downward; This pair doth constitute the *Cerebellum* of this Fish.
- + *ee.* The *Medulla Spinalis* + is much akin to that of other Fish in situation and Figure.

Fig. 2. *The Head of a Grey Mullet opened.*

The Brain of this delicate Fish is composed of Three pair of Protuberancies.

- + *aa.* The First + is beautified with a kind of Triangular shape.
- + *bb.* The Second pair of Processes + is adorned with an orbicular shape.
- + *cc.* The Third pair + is dressed with an Oval Figure, parted by a Fissure in the middle, into two equal parts, which make the *Cerebellum*.
- + *dd.* The optick Nerves + are like those of other Fish in situation and progress, and do arise under the first pair of Processes, and take an oblique transverse course toward the inside of the Eyes.

Fig. 3. *The Head of a Salmon-Peal opened.*

The Brain of this Fish is made up of three pair of Prominencies.

- + *aa.* The First pair + are very small, and dressed with an orbicular Figure.
- + *bb.* The Second pair + are much greater then the First, and are decked with an oblong Oval Figure.
- + *cc.* The Third pair + are Ovals, and as I conceive, do represent the *Cerebellum*.
- + *dd.* The *Medulla Spinalis* + is the same with other Fish both in Shape and Situation.

Fig. 4. *The Head of a Horse-Mackerel opened.*

The Brain of this Fish seemed to be composed of many Processes.

- + *a.* The First rank + is three in number, endued with a Globular Figure.
- + *bb.* The Second rowe + is a pair of Oval Protuberancies, much exceeding the other in bigness.
- + *c.* The Third seemeth to consist of three Processes.
- + *dd.* The middle one + is endued with an orbicular Shape, and the other being lateral, seem to be endued, as far as they appear, with Semi-circular Figures.
- + *e.* The posterior Processes +, being the *Cerebellum*, is dressed with a Triangular Figure.
- + *ff.* The *Medulla spinalis* + is divided into two equal parts, by the mediation of a Fissure.

Fig. 5. *The lower region of the Brain of a Horse-Mackerel.*

The lower region of the Brain of a Horse-Mackerel is composed of four Protu-

- + *aaaa.* berancies +, which are endued with a Globular Figure.

Fig: 1.

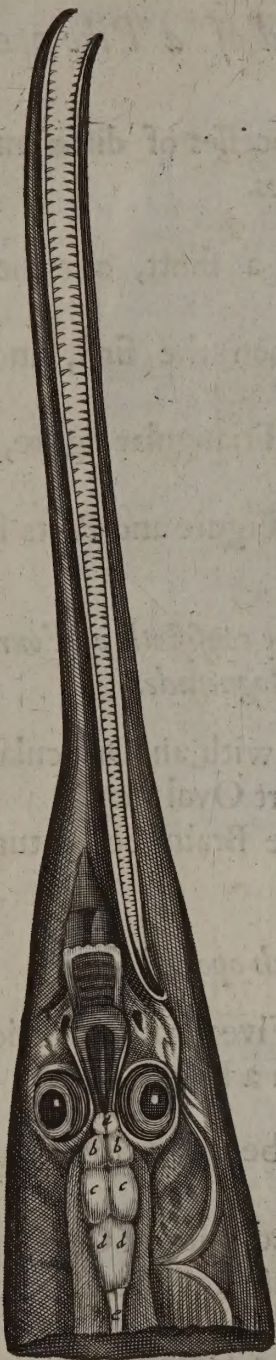


Fig: 3.

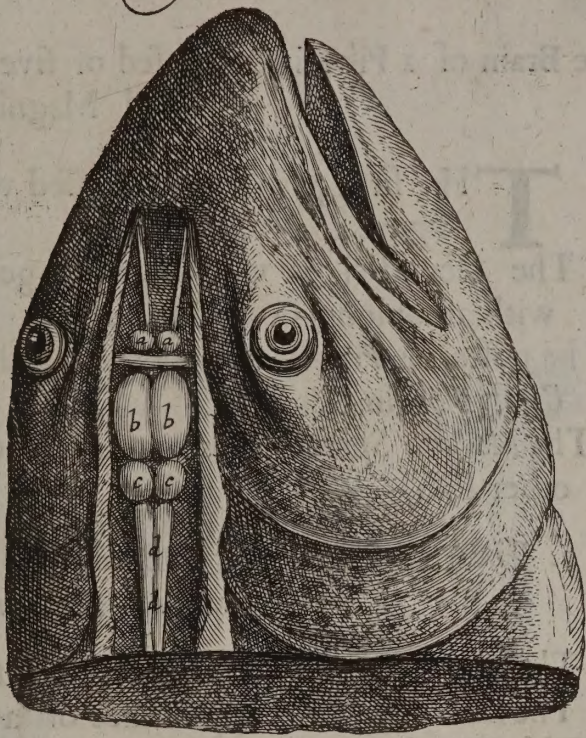


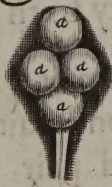
Fig: 2.



Fig: 4.



Fig: 5.



Tab. LXIX. Fig. 1. *The Head of a Pike opened.*

The Brain of a Pike is composed of five Processes of different Figures and Magnitudes.

- † *a a.* **T**He first pair † are dressed with a short, or rather Orbicular figure.
- † *b b.* The second † is very much larger then the first, and beautified with an oblong Oval figure.
- † *c.* The posterior Process † is adorned with a Triangular figure, and is the *Cerebellum* in this Fish.
- † *d.* The *Medulla Spinalis* † is not different in Figure and Parts from that of other Fish.

Fig. 2. *The lower Region of the Brain of a Pike consisteth of Four Processes different in Figure and Magnitude.*

- † *a a.* The two uppermost † seem to be dressed with an Orbicular figure.
- † *b b.* The last † have the appearance of a short Oval shape.
- † *c c.* The Optick Nerves † in the Base of the Brain being turned up, do plainly appear to Intersect each other.

Fig. 3. *The Head of a Tench opened.*

The Brain of a Tench is composed also of Five Protuberancies somewhat different in Figure from a Pike.

- † *a.* The first pair † are the least, and seem to be endued with a short Oval figure.
- † *b b.* The second pair † of Processes are adorned with an Oval figure.
- † *c.* The posterior Process † seemeth to be beautified with an Orbicular figure.

Fig. 4. *The lower Region of the Brain of a Tench is composed of Three Processes.*

- † *a.* The first Process † is endued with an Oval shape.
- † *b b.* The pair of Protuberancies † are adorned with an Oval figure.

Fig. 5. *The Head of a Pearch opened.*

This Brain is much different from that of the Third Figure of the Sixty sixth Table, and consisteth of Ten Protuberancies.

- † *a a.* The first pair † are dressed with a kind of Orbicular figure.
- † *b b.* The second pair † are adorned with an Oval shape.
- † *c c.* The third pair † of Prominencies are trimmed with an Orbicular figure.
- † *d.* The seventh Process † is beautified with a kind of Triangular figure.
- † *e.* The three last Processes † are placed after the manner of a Triangle, and are endued with several shapes and sizes.

Fig: 1

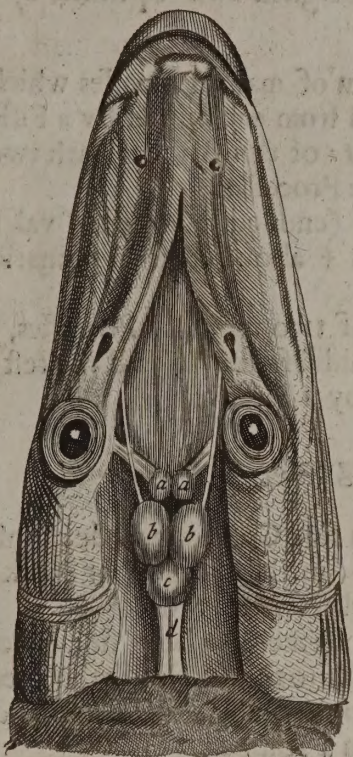


Fig: 2.

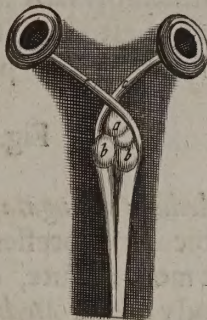


Fig: 3.



Fig: 4.



Tab. LXX. Fig. 1. *The Medulla Oblongata and Spinalis of Animals.*

The *Medulla oblongata* of a Rabbet is a system of many Processes which are seated in
 † *a a a a a.* † *b b b.* a double row † parted from each other by a Fissure †.
 † *c c c c.* † *d d.* The origen † of *Medulla oblongata* of this Animal hath two Arms †, and
 each of them is composed of four or five Processes.
 † *e e e e e e.* The ranks have smaller Processes † (endued with an Oval figure, toward
 † *f f f f.* the beginning, and have large Ovals † about their termination, and end in
 † *g g.* three orbicular Processes †.
 The *Medulla Spinalis* is made up in its origen of two ranks of Processes, the two high-
 † *h h.* † *i i i i.* est † are beautified with a Pyramidal figure †, and the rest seem to be pa-
 † *k k.* rallelograms, † parted from each other by a Fissure.

Fig. 2. *The Medulla oblongata of a Gray Mullet.*

The *Medulla oblongata* of a Gray Mullet, is a fine Compag made up of many ranks of
 † *a a.* orbicular Processes, and have only three (in their origen or Neck †) which are
 † *b b.* the more minute, out of which the Optick Nerves † do arise.
 The body of the *Medulla Spinalis* in this Fish seemeth to be a fine system composed of
 † *c c.* five Orbicular Processes, of which the next to the Neck are the greatest †.
 † *d d.* The *Medulla spinalis* is divided into two parts, by a Fissure †, and doth not con-
 sist of any Processes, which are found in a Rabbet.

Fig. 3. *The lower Region of the Medulla oblongata and Spinalis of a Gurnard.*

The lower Region of a Gurnard seemeth to be made up of five Processes, the anterior
 † *a a.* are a pair † much larger then the rest, endued with an Oval figure; out of these
 † *b b.* Processes arise the Optick Nerves †, intersecting each other.
 † *c.* The three posterior Protuberancies † are very minute, beautified with an Orbicular
 shape.
 The *Medulla oblongata* is framed of two rows of Processes, of which the anterior Pro-
 † *d.* tuberancies † are the most large, and grow less toward their termination, and are all
 of an Oval figure.
 † *e e.* The *Medulla Spinalis* is parted by a Fissure †, and destitute of Processes.

Fig. 4. *The Medulla oblongata of a Carp.*

The *Medulla oblongata* of a Carp, is composed of two ranks of Protuberancies (parted
 † *a a.* from each other by a Fissure †) beautified with an Orbicular figure.
 † *b.* Its Origen consists in two single Processes, of which the first † is of a kind of Oval
 † *c.* † *d.* figure †, and the second is adorned with an Orbicular †.
 † *e e.* The first pair of Processes † are the greatest, and lead the Van in the Company
 of Protuberancies, which grow less and less as they approach the *Medulla Spinalis*
 † *f f f.* composed of two parts, severed from each other by a Fissure †.

Fig. 5. *The Medulla oblongata and Spinalis of a Pike.*

† *a.* The *Medulla oblongata* of a Pike beginneth in an apex or obtuse Cone †, and the body
 of the *Medulla* is a Compag framed of four rows or more of small Orbicular Pro-
 cesses.
 The *Medulla Spinalis* in this Fish as well as most other, is constituted of two parts
 † *b b.* separated from each other by a Fissure †.

Fig. 6. *The Medulla oblongata and Spinalis of a Gudgeon.*

The *Medulla oblongata* of a Gudgeon is integrated of a double rank of Protuberancies
 endued with a round shape.
 † *a.* Its Origen † begins in an obtuse Cone, and seemeth to be composed of three ranks
 † *b b b.* of small Processes † of an Orbicular figure.
 † *c c.* The body † of the *Medulla oblongata* is framed of a double rank (severed by a
 † *d d.* Fissure †) beginning large, and growing less and less as they come toward the
 † *e e e.* *Medulla Spinalis*, which is divided into two parts by a Fissure † running all along
 the Spine.

Fig: 1.

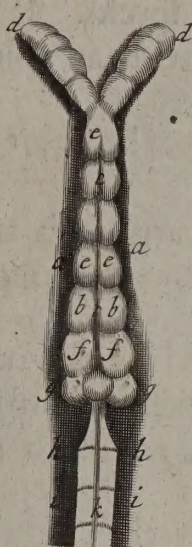


Fig: 2.



Fig: 3.

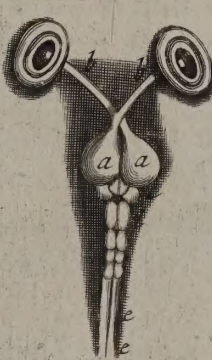


Fig: 4.



Fig: 5.



Fig: 6.



Tab. L X X I. Of a young Dog-fish, called by the
Latines Canis Cachaorius.

TH E Skin above the Mouth is dressed with Nerves and Semi-circular streaks, interspersed with numerous specks.

a. The Heart of this kind of Dog-fish is endued with an oblong round Figure, ending in an obtuse Cone.

b. And hath as other Fish, one Anricle lying under the Heart placed in a supine position.

c. The great Artery (seated in the Base of the Heart) is beautified with a triangular Figure, and afterward groweth small, being divided into two Branches.

d d. The Liver is turned up, and is naturally seated for the most part in the Left side, consisting of two Lobes, of which that of the Left side is the greatest, and the Right hath a Fissure, and two or three little Creces.

e. The beginning of the Stomach is much larger then its termination, as confining on the Gullet in the Left side.

f. The termination of the Stomach or *Pylorus*, is much more narrow then the Origen.

g. The body of the Stomach is beautified with a kind of round Oval Figure and dressed with numerous branches of Blood-vessels.

h. The entrance of the *Duodenum* is beset on each side with an *Intestinum*
ii. *Cæcum*, (adorned with a conick Figure) of which that of the Right side is the greatest, and most long, and endued with short Gyres.

j. The *Duodenum*, passeth down the Right side of the Stomach in a right course, and afterward the Guts make many Mæanders, or Circumvo-

k. lutions, and at last end into the *Intestinum rectum*, making its progress to the *Anus* in an oblique posture, into which it discharges its bilious excrements.

l. The *Vesicula felleis* is lodged among the Guts, and is endued with a kind of Conick, or rather Oval Figure, and a yellowish colour.

The *Pancreas* is lodged under the Intestines in the Left side, hath a double Origen near the bottom of the Stomach to which they are fastened, and consisteth of diverse partitions, and maketh its progress in many Gyres, somewhat resembling the Intestines.

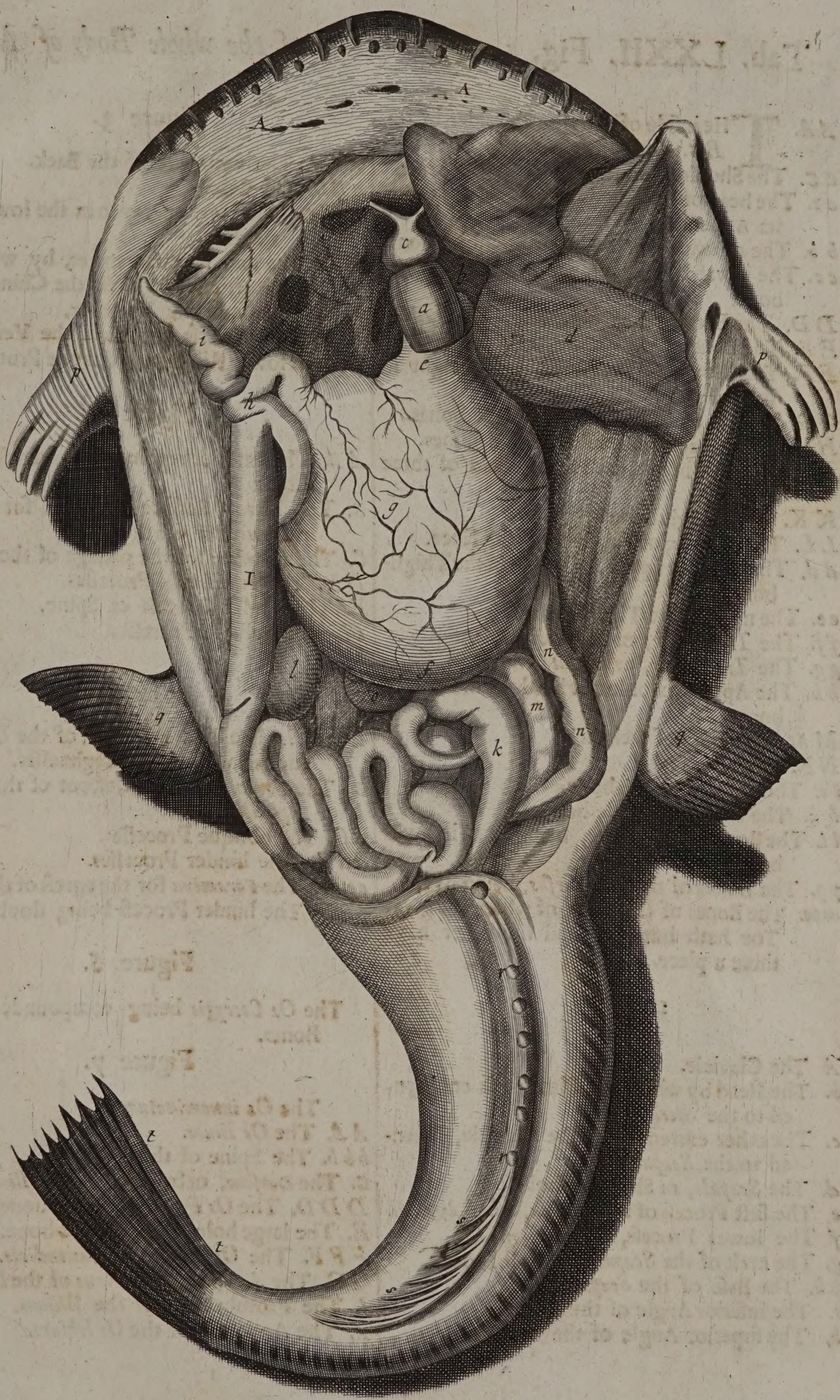
m. The upper surface of the *Pancreas* is Convex, and hued with an Ash-colour, and the lower Surface *n n.* is Concave, and is endued with a White colour shaded with Red, hath a Trunk of a Blood-vessel, passing in a straight course in the middle, beset on each side with many divarications of small Ramulets.

o. Part of the Spleen seated under the Stomach, and is beautified with an Oval Figure, and hued with a Purple colour, all beset with many branches of Blood-vessels.

p p. This Fish hath four Finns, the two upper are the smallest, of a white colour, somewhat resembling little hands.

q q. The lower Finns are in some part adorned with a White colour, interspersed with Black spots, and fringed with Black, and dressed with many Creces

The inside of the Tail is beset in the middle with many Quadrangular Bones *† r r.* passing in length toward the Tail (attended with many Filaments *† s s.*) ending into many Creces; at the termination of the *† t t.* Tail *†* resembling a Fann.



Tab, LXXII, Fig. 1. *The Skeleton of the whole Body of Man.*

- AA.** The inside of both the Shoulder-bones.
BB. Both the Clavicles.
CC. The Shoulder-bone, or Bone of the Arme.
aa. The head of the Shoulder-bone coming from its Appendix.
bb. The outward knob of each Shoulder-bone.
cc. The inward Protuberance of the Shoulder-bone.
DD. The Bone of the Cubit, called the *Radius*.
EE. The Bone of the Cubite, called the *Ulna*.
FF. The Bones of the Wrist, being eight in number.
GG. The Thumb, composed of three Bones.
HH. The Metacarpe, framed of four Bones.
II. The four Fingers, each being made of three Bones.
KK. The Thigh-bone.
LL. The *Pasella*, or Pan-bone of the Knee.
dd. The head, or upper Appendix of the Thigh-bone.
ee. The neck of the Thigh-bone.
ff. The *Trochanter*, or *Rotator major*.
gg. The *Trochanter*, or *Rotator minor*.
hh. The Appendix, or lower heads of the Thigh-bone.
MM. The *Tibia* of each Leg.
NN. The *Fibula*.
ii. The inward Ankle-bone.
kk. The outward Ankle-bone.
ll. The Bones of the *Tarsus*, being seven in number.
pp. The Bones of the *Metatarsus*, being five.
mm. The Bones of the Toes, of which the great Toe hath but two, and the other have three a piece.

Figure 2.

- A.** The Clavicle.
b. The Head by which the Clavicle is conjoyned to the *Sternum*.
c. The other extremity of the Clavicle, fastened to the *Scapula*.
d. The *Scapula*, or Shoulder-bone.
e. The first Process of the *Scapula*, called *εχρῖσμα*.
f. The lower Process, called *ωρεοκονίδης*.
g. The neck of the *Scapula*, or least Process.
h. The Base of the *Scapula*.
i. The inferior Angle of the *Scapula*.
k. The superior Angle of the *Scapula*.

Figure 3.

- AAA.** The vertebres of the Back.
BBB. The Ribs.
CCCC. The *Sinus* engraven in the lower part of the Rib.
DD. The two Protuberancies, by which they are articulated with the *Chine*.
E. The *Sinus* of the Verteber.
F. The Transverse Process of the Verteber.
G. The lower Rib having but one Protuberance.

Figure 4.

- AA.** The anterior region of the verteber of the Loins.
B. The lower Surface, covered for the most part with a Cartilage.
C. The *Foramen* for the passage of the *Medulla*.
DD. The Transversal Processes.
E. The hinder Process or Spine.
II. The oblique Processes.

Fig. 5.

- AAAA.** The hinder Region of the *Os Sacrum*, endued with many roughnesses.
B. The *Foramen* for the descent of the *Medulla Spinalis*.
CC. The oblique Processes.
ddd. The hinder Processes.
eeee. The *Foramina* for the egress of the Nerves.
ffff. The hinder Process being double.

Figure 6.

The *Os Coccygis* being compounded of four Bones.

Figure 7.

The *Os innominatum*.

- AA.** The *Os Ilium*.
bbb. The Spine of the *Os Ilium*.
C. The *Dorsum*, or back of the *Os Ilium*.
DDD. The *Os Pubis*, or Share-bone.
E. The large hole of the Share-bone.
FFF. The *Os Ischium*, or *Coxendicis*.
GG. The *Acetabulum*, or *Sinus* of the *Ischium*.
I. The Protuberance of the *Ischium*.
K. The Appendix of the *Os Ischium*.



Tab. LXXIII. Fig. 1. *The Kidneys, Ovaries, and Ovi-
ducts, &c. of an Estridge.*

a a. **T**HE Origen of the Kidneys relating to an Estridge, is endued with a kind of an Oval Figure.

b b b b. The oblong Processes of the Kidneys being less then their Originations.

c c c c. The body of the Kidneys are beautified with a kind of Conick Figure, and are much larger then the Origins and oblong Processes.

These several parts of the Kidneys are adorned with many Globules, of various shapes and sizes.

d d. The emulgent Blood-vessels.

e e. The Ureters creeping out of the Terminations of the Kidneys, and end near the Vent.

f f. The Ovaries consisting of many Eggs of diverse Magnitudes.

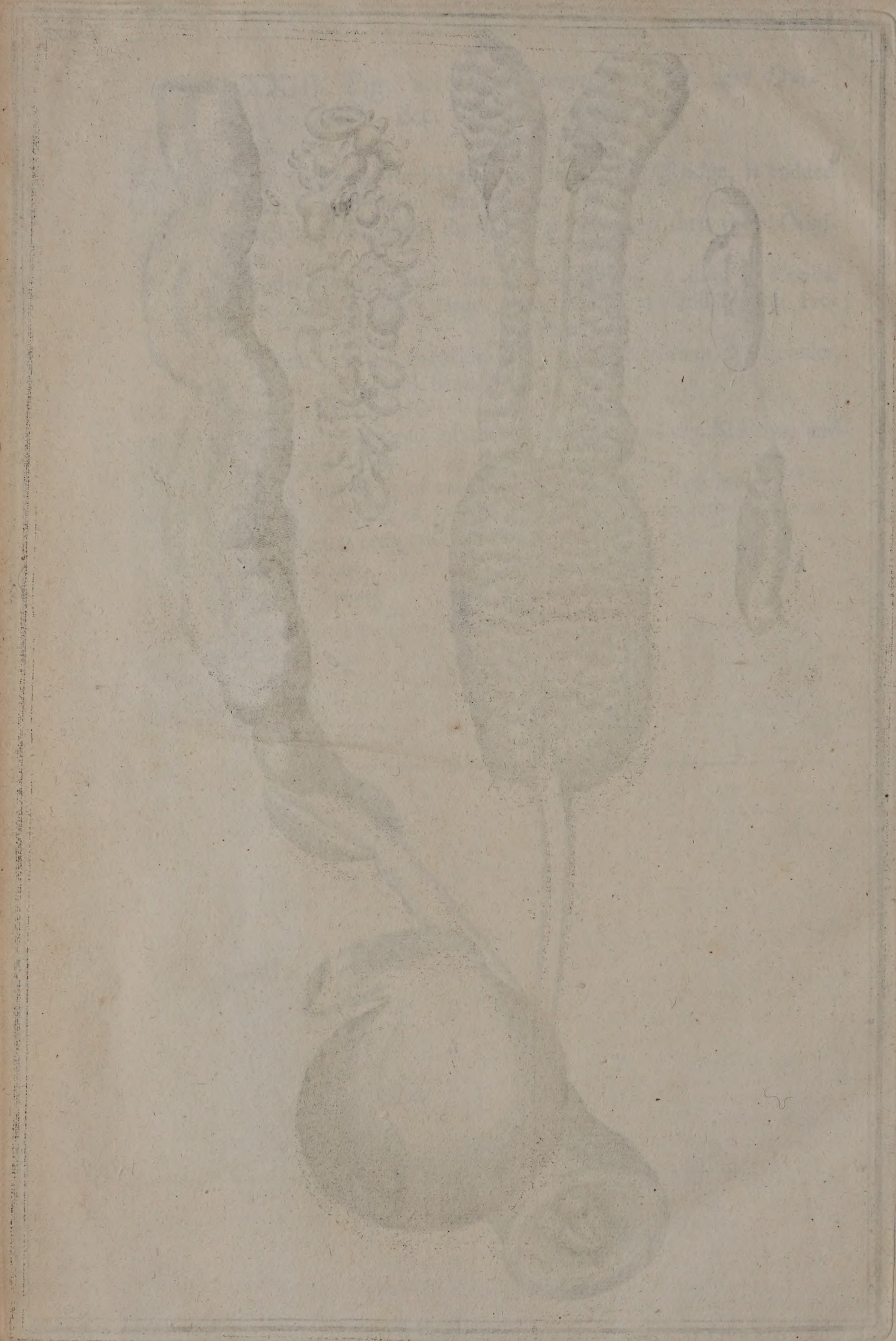
g g. The Oviduct consisting of various Mæanders, inserted into the Uterus,

h. The Cloaca, or great receptacle of Excrements.

i. The *Intestinum rectum*.

k k. The *Glandulæ renales*.





A N
I N D E X
O F

Words and Memorable Things

Contained in both VOLUMES.

A.

- A**cid Recrements vitiate the nervous Liquor, and may be discharged by Vomiting. 1158
- Acidity is an imperfect degree of Concoction. 307
- Acidity is produced by the fusion of saline Elements. Ibid.
- The acide Spirits of Vegetables, resemble the acide parts of the Blood. 1148
- Action and Passion are different Modalities of the same Entity. 231
- Acute Fevers proceed à prohibita transpiratione. 57
- Adipose Ducts of the Caul, resemble Network. 183
- Adipose Ducts associate with the Blood-vessels. 184
- The Origen of the Adipose Ducts are the Stomach and Guts. 186
- Ethereal particles made up of regular Angles, move with great swiftness in right lines. 64
- Ethereal Bodies, being subtil, do insinuate into various Liquors. 28
- Agents and Patients do mutually act, as conform in Texture, wherein the small particles of Agents are suitable in shape and size with the Pores of Patients. 37
- Air is exalted by Celestial Emanations. 29
- Air is of an expansive Nature, and is light in its own Nature, and groweth ponderous, as embodied with steams, as their vehicle 34
- Air is called by Mr. Hook, Tincture of Earthy and watry bodies dissolved into it. 30
- Air is rendred fermentative, as affected with the effluxes of Vegetables. 31
- The manner how Air incorporated with steams is conveyed from the surface to the inward recesses of the Body. 395
- Air being of an expansive Nature, much advances the growth of Plants. 39
- The Air-vessels of Plants 821 and how they are encircled with lignous Processes, and how they have an intercourse with Sap-vessels, and their uses. 822, 823
- The passage how Air is conveyed into the Mouth of Birds. 1099
- The Air is forced into the Lungs by the weight of the Superincumbent Atmosphere, and the Air by its elastick Particles, assisteth the inflation of the Lungs. 832
- Air insinuates into the inward part of the Brain, and mixeth with the Succus nervosus. 1001
- The Air consisting of various steams, embodied with the Blood, (made up of Heterogeneous Particles) hath great contests, by which the different parts are brought to a due temper, and in some sort assimilated. 41
- The attraction of Aliment is not found in the Stomach but Mouth. 201
- Attraction of Aliment cannot proceed from a Vacuum. 291
- The Aliment is protruded into the Stomach. 292
- The Aliment is prepared in the Mouth with Salival Liquor, and as inspired with Airy and Ethereal Particles. 297
- The Aliment is not only acted with serous and nervous Ferments, as proper Menstruums in the Ventricles, but also exalted with vital heat, tanquam Bal. Mar. whereby the Aliment is extracted in the Stomach by Colligation. 297
- Liquid Aliment having enlarged Pores, is more easily concocted then solid. 310
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[*]

Aliment

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